Department of the Air Force

FINAL ENVIRONMENTAL PLANNING TECHNICAL REPORT

AIR QUALITY

January 1984

Air Force
Environmental Planning Division
(HQ USAF/CEVP)

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FINAL ENVIRONMENTAL PLANNING
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PREFACE

The President has directed that the Air Force deploy the Peacekeeper missile system at a location near F.E. Warren Air Force Base (hereafter F.E. Warren AFB), close to Cheyenne, Wyoming. The Peacekeeper system (formerly known as the M-X system) is an advanced, land-based intercontinental ballistic missile. The plan calls for the replacement of 100 existing Minuteman III missiles with 100 Peacekeeper missiles. Existing missile silos will be used, and there will be very little structural modification needed. Missile replacement will occur within the two squadrons (of 50 missiles each) located nearest F.E. Warren AFB, the 319th and 400th Strategic Missile Squadrons. Peacekeeper deployment will occur between 1984 and 1989.

An environmental impact statement (EIS) was prepared for the Proposed Action as outlined above. Information contained in the EIS is based upon environmental information and analysis developed and reported in a series of 13 final environmental planning technical reports (EPTRs). This volume is one of those reports. The 13 resource areas are:

- Socioeconomics (employment demand, housing, public finance, construction resources, and social well-being);
- Public Services and Facilities;
- Utilities;
- Energy Resources;
- Transportation;
- Land Use (land use, recreation, and visual resources);
- Cultural and Paleontological Resources;
- Water Resources;
- Biological Resources;
- Geologic Resources;
- Noise;
- Air Quality;
- Jurisdictional.

CONTENTS Page

CONTENTS

Page

CONTENTS

LIST OF TABLES

LIST OF TABLES

LIST OF FIGURES

1.0

INTRODUCTION

1.0 INTRODUCTION

This final environmental planning technical report (EPTR) is a companion document to the air quality section of the final environmental impact statement (FEIS) for the Peacekeeper in Minuteman Silos project. It provides data, methodologies, and analyses which supplement and extend those presented in the FEIS.

This final EPTR consists of six major sections and appendices. Section 1.0 provides an overview of the Peacekeeper in Minuteman Silos project and a description of the air quality resource and its elements.

Section 2.0 presents a detailed description of the environment potentially affected by the project. It includes a capsule description of the environmental setting (Section 2.1) and project requirements (Section 2.2). Section 2.3 defines the Region of Influence and Area of Concentrated Study for the resource. Section 2.4 (Derivation of Data Base) follows with a discussion of the literature sources, group and agency contacts, and primary data which provide the data base for the report. Section 2.5 describes analytic methods used to determine existing environmental conditions in the Region of Influence. Detailed analyses of the existing environment, broken down by constituent elements of the resource, follow in Section 2.6.

Section 3.0 describes environmental consequences of the Proposed Action and its project element alternatives, the No Action Alternative, mitigation measures, and unavoidable impacts. It contains detailed definitions of each potential level of impact (negligible, low, moderate, and high) for both short-term and long-term impacts. Beneficial effects are also discussed. Definitions of significance are also included. Methods used for analyzing future baseline and project impacts are described, as are assumptions and assumed mitigations. Additional mitigation measures to reduce project impacts are also described.

Sections 4.0 (Glossary), 5.0 (References), 6.0 (List of Preparers), Appendix A (Air Quality Model Descriptions), Appendix B (Air Quality Assumptions), Appendix C (Emission Factor and Visibility Screening Calculations), and Appendix D (Regional and Project-Related Emissions) conclude the EPTR.

1.1 Peacekeeper in Minuteman Silos

The Peacekeeper system, which the Air Force plans to deploy within the 90th Strategic Missile Wing at F.E. Warren Air Force Base (AFB), Wyoming, is an advanced land-based intercontinental ballistic missile system designed to improve the nation's strategic deterrent force. Deployment of the Peacekeeper calls for replacement of 100 existing Minuteman III missiles with 100 Peacekeeper missiles. Missile replacement will occur in the 319th and 400th Strategic Missile Squadrons, located nearest F.E. Warren AFB (Figure 1.1-1). The Deployment Area covers parts of southeastern Wyoming and the southwestern Nebraska Panhandle.

Construction at F.E. Warren AFB will occur between 1984 and 1986. Fourteen new buildings will be constructed, and modifications or additions will be made to 11 existing buildings. Approximately 400,000 square feet of floor space will be built or modified. A new road configuration, to be selected from three alternatives, is proposed to link Peacekeeper facilities onbase and to provide improved access to or from the base (Figures 1.1-2, 1.1-3, and 1.1-4). Work in the Deployment Area will take place between 1985 and 1989. Many of the access roads to the Launch Facilities will be upgraded. Bridge clearance problems will be corrected, and some culverts and bridges may need to be upgraded. Below-ground modifications will be related to removal of Minuteman support hardware, insertion of a protective canister to enclose the Peacekeeper, and installation of communications systems and support equipment.

A total of 11 alternatives have been chosen as candidate routes for communication connectivity between Squadrons 319 and 400 (Figure 1.1-5). Five routes will be selected for installation. Total buried cable length will range from approximately 82 to 110 miles, depending upon final route selections.

Under the Proposed Action two dispatch stations would be established, one each in the northern and eastern portions of the Deployment Area. Although actual locations have not been selected, Chugwater, Wyoming and Kimball, Nebraska are representative locations analyzed in the Final Environmental Impact Statement and in this EPTR. Dispatch stations would be not more than 5 acres in size and would be used for the temporary open storage of equipment and material. One or more buildings would also be present at each site for contractor use as office space. All dispatch stations would be removed prior to project completion. In addition to the Proposed Action, two alternatives are considered in this environmental impact assessment:

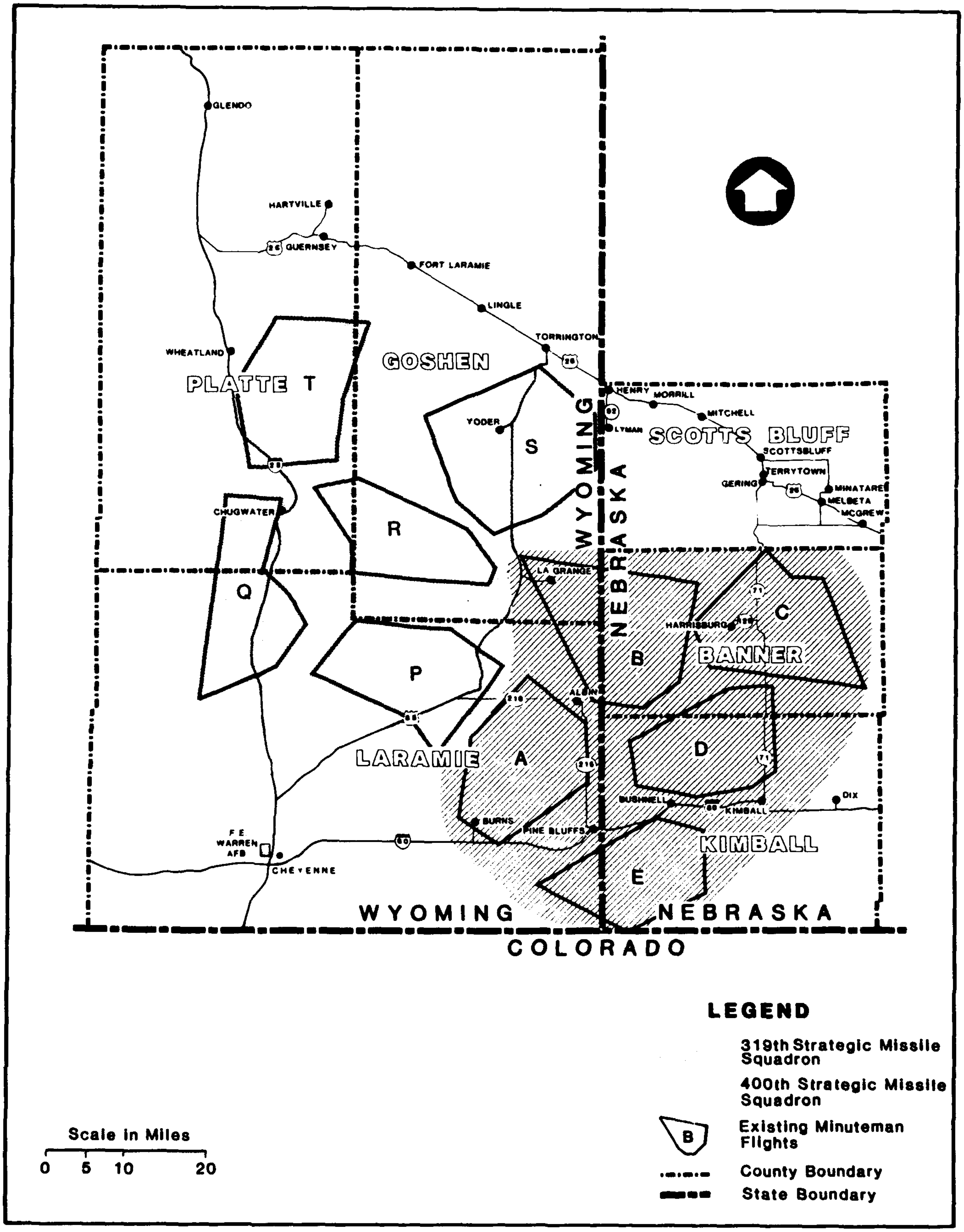
1) One dispatch station only, in the eastern part of the Deployment Area; or

2) No dispatch stations.

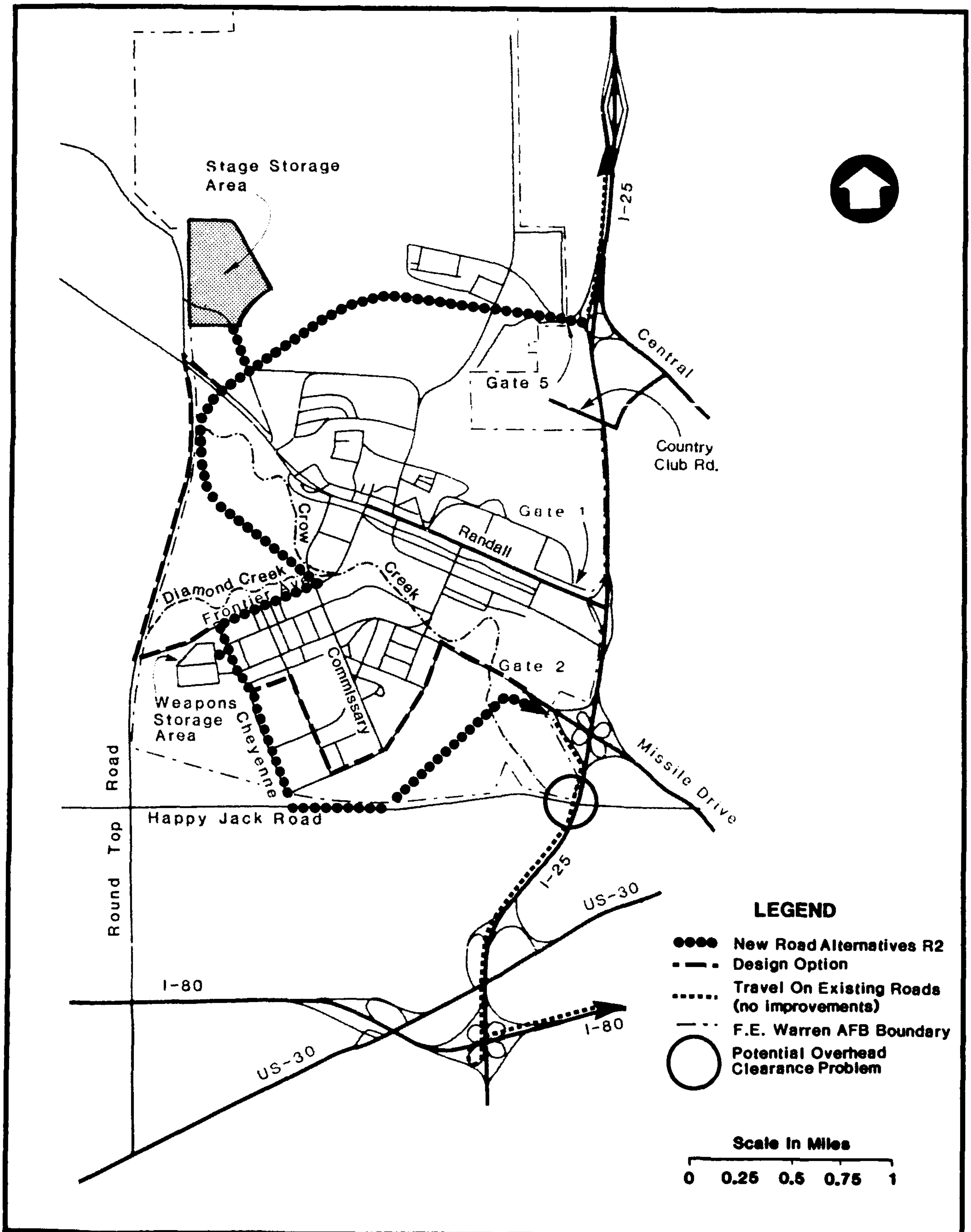
Two options have been identified for resurfacing Deployment Area roads. Surfacing Option A involves gravel upgrades of 252 miles of existing gravel roads and the paving or repaving of 390 additional miles of gravel and asphalt roads. Surfacing Option B involves the paving or repaving of all 642 miles of gravel and asphalt roads listed in Surfacing Option A.

Direct manpower for construction, assembly and checkout, and operation of the system will peak during 1986 when an average of nearly 1,600 persons will be required. In 1991, following deployment, the remaining increased operational workforce at F.E. Warren AFB will consist of about 475 persons. Table 1.1-1 presents the average annual workforce, based on quarterly estimates for each year of construction.

Table 1.1-2 shows the average number of jobs including those which are considered to be filled by available labor; as well as those filled by weekly commuters and immigrants, on an annual average basis. In general, locally available labor will fill all the road and construction jobs.

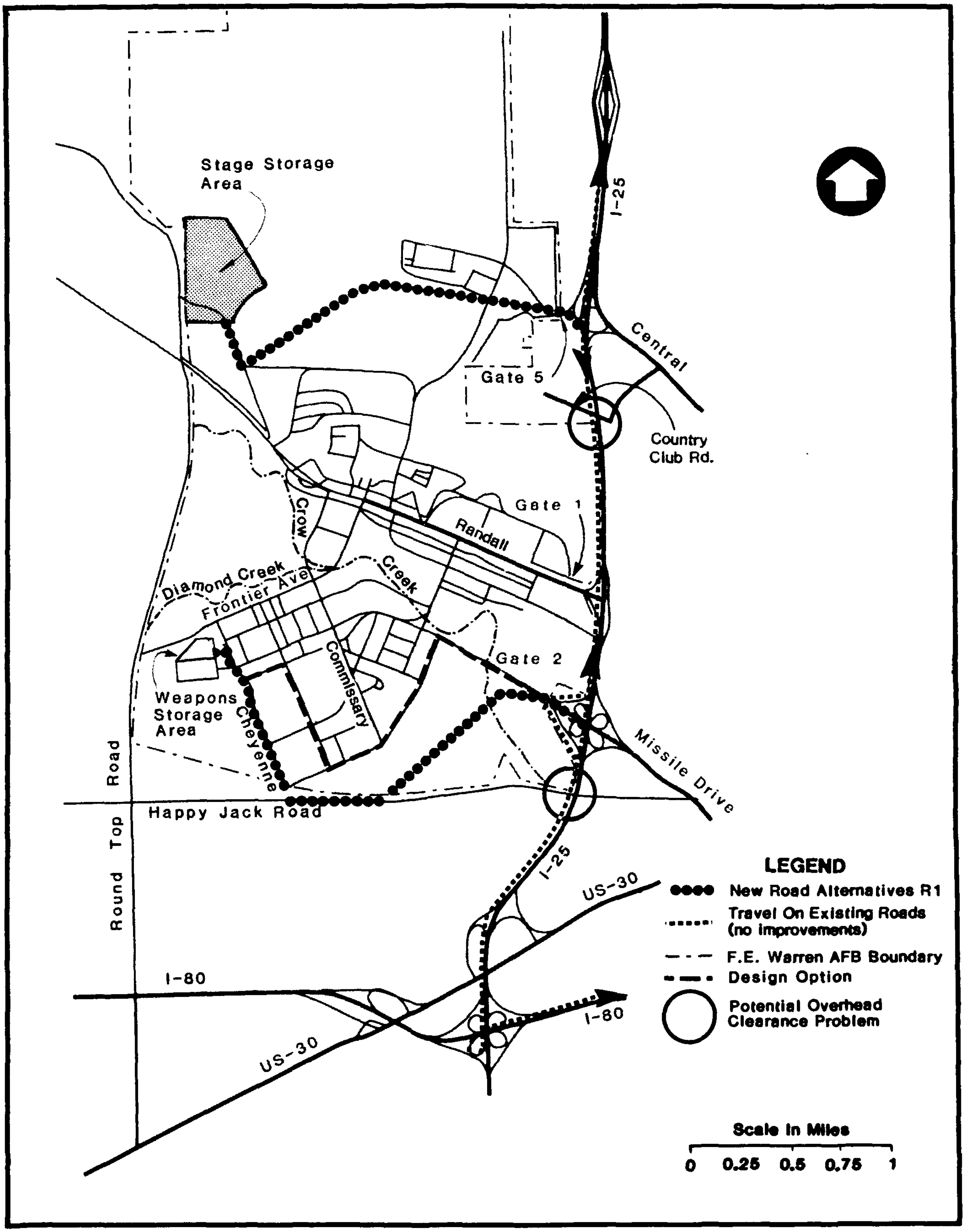


PEACEKEEPER DEPLOYMENT AREA FIGURE NO. 1.1-1



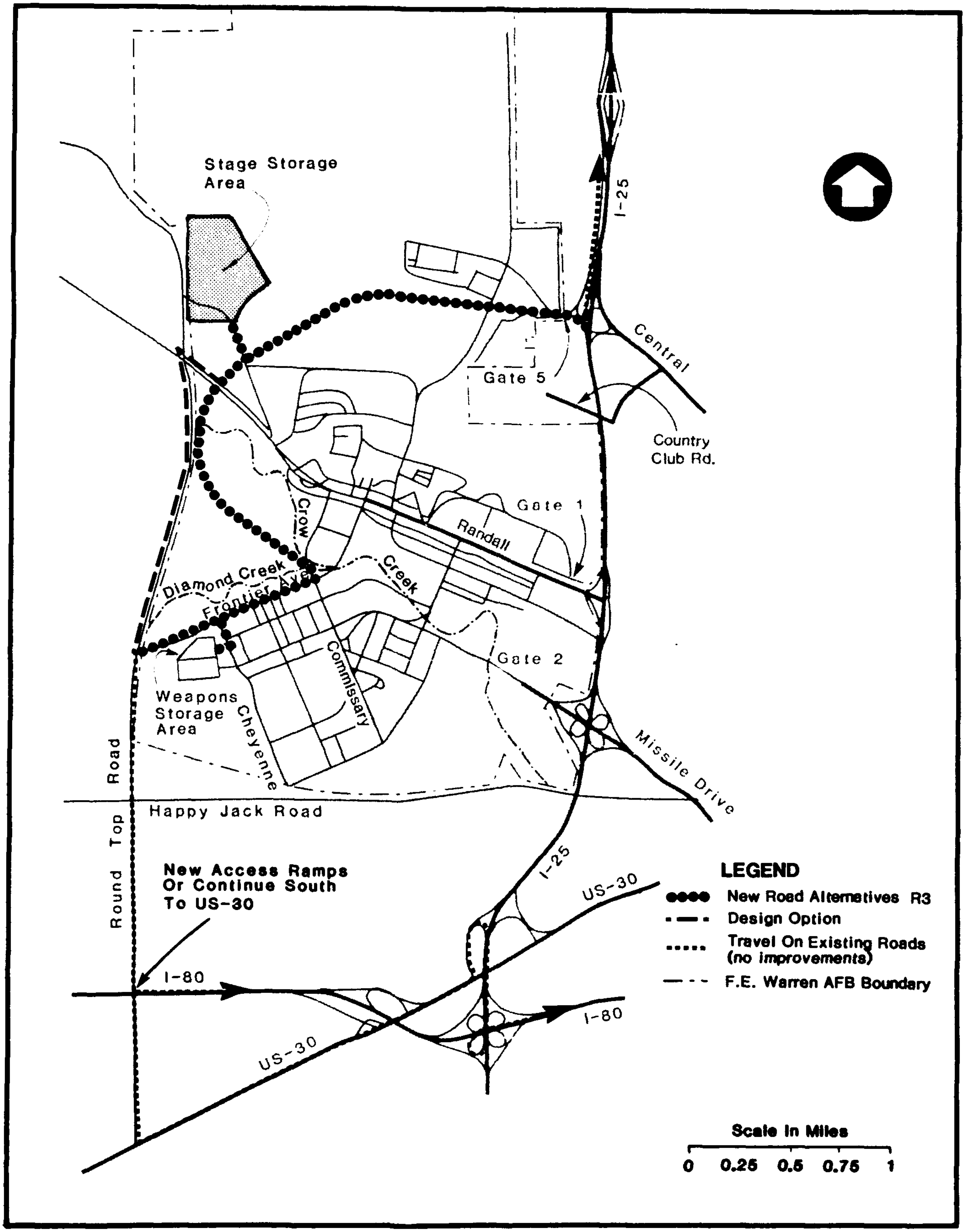
NEW ROADS AT F.E. WARREN AFB: PROPOSED ACTION R2

FIGURE NO. 1.1-2



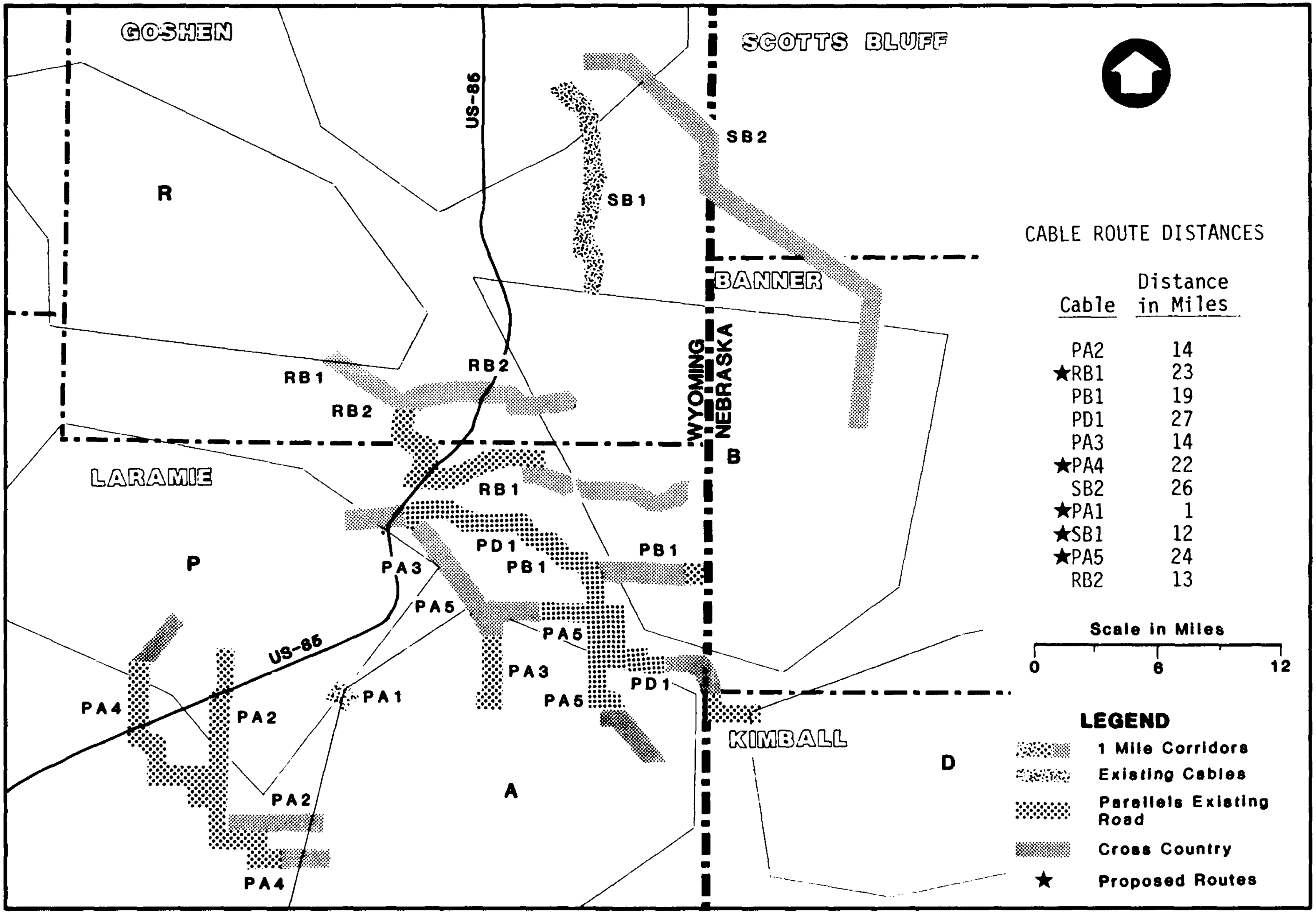
NEW ROADS AT F.E. WARREN AFB: ALTERNATIVE R1

FIGURE NO. 1.1-3



NEW ROADS AT F.E. WARREN AFB: ALTERNATIVE: R3

FIGURE NO. 1.1-4



CABLE ROUTE DISTANCES

Cable	Distance in Miles
PA2	14
★RB1	23
PB1	19
PD1	27
PA3	14
★PA4	22
SB2	26
★PA1	1
★SB1	12
★PA5	24
RB2	13

ALTERNATIVE CABLE ROUTES

FIGURE 1.1-5

As a result of the purchase of materials in the project area and the local expenditures of project employees, additional jobs will be created in the region. These jobs are estimated to number as follows:

Year:	1984	1985	1986	1987	1988	1989	1990	1991 & on
Indirect Jobs:	105	1,180	1,080	1,010	705	550	143	115

Estimated materials and costs for the project, based on total project budgetary considerations, are shown by Standard Industrial Classification in Table 1.1-3.

A number of construction and support materials will be obtained from sources within the project area. Among the materials exerting a major influence on assessment of project impacts are aggregate (4.6 million tons), water (516 acre-feet), fuel (7.6 million gallons), and electricity (3.8 million kWh). In the case of water supply for construction, the Air Force will identify and, if necessary, obtain permits for the water or purchase existing water rights.

1.2 Description of Resource

Air quality is defined as a descriptive measure of the cumulative quantity of pollution in the air. The term air quality refers to the condition of the atmosphere due to emissions from natural and manmade sources and is typically measured with respect to health and visibility implications. Air pollutants were analytically evaluated, based on expected increases in emission quantities for the level of activity associated with this project. These include carbon monoxide (CO), resulting primarily from transportation (mobile) sources, and fugitive dust, resulting primarily from such activities as vehicular travel on unpaved surfaces, overburden disturbances, and erosion. For justification, see Section 3.1. The impact of air pollution on regional visibility is also evaluated.

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Table 1.1-3

ESTIMATED MATERIAL REQUIREMENTS
BY STANDARD INDUSTRIAL CLASSIFICATION

Industrial Classification	Estimated 1982 Dollars (1,000s)
Fabricated Structural Metal	$22,999
Unclassified Professional Services and Products	14,358
Cement and Concrete Products	10,862
General Wholesale Trade	8,890
Structural Metal Products[1]	11,983
Millwork, Plywood, and Wood Products[1]	3,941
Copper, Copper Products	3,902
Electrical Lighting and Wiring	3,871
Stone and Clay Mining and Quarrying	39,728
Stone and Clay Products[1]	2,955
Basic Steel Products	1,233
Heating and Air Conditioning Apparatus	1,525
Plumbing and Plumbing Fixtures	938
Petroleum Refining and Products	5,148
Material Handling Equipment	1,970
Sawmills and Planing Mills	1,478
Paints and Allied Products	1,478
Plastic Products[1]	1,478
Furniture and Fixtures	986
Structural Clay Products	986
General Hardware	986
Scientific Instruments	986
Rail Transport	986
Real Estate	986
Construction, Mining, and Oilfield Machinery	749
TOTAL:	$145,402

Note: [1] Not included in other Industrial Classifications.

AFFECTED ENVIRONMENT

2.0 AFFECTED ENVIRONMENT

2.1 General

2.1.1 Climatology/Meteorology

This study utilizes surface meteorological data collected by the National Weather Service at the Cheyenne Airport and upper air meteorological data collected in Denver. These data are considered representative of the project area. Locations of other meteorological stations in the region are shown in Figure 2.1-1.

The climate in the vicinity of Cheyenne and the Deployment Area (DA) is influenced primarily by air masses moving in from the Pacific Ocean. The climate is distinctively semiarid since the mountain ranges to the west act as an effective moisture barrier. The mean annual precipitation, approximately 15 inches, occurs primarily between the months of March and October as shown in Table 2.1-1.

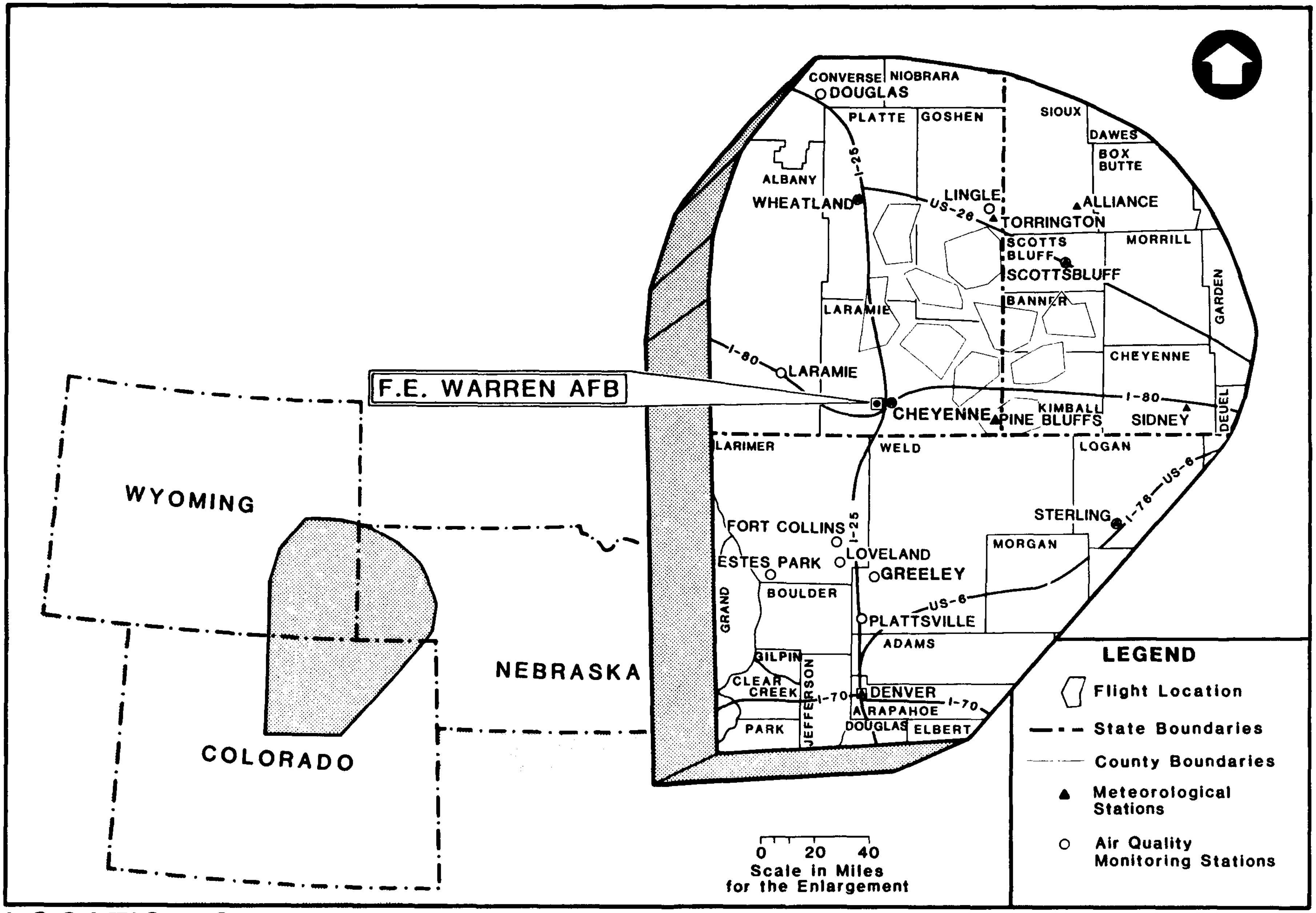
The region experiences large diurnal and annual temperature ranges. The daily range averages about 30°F in the summer and 23°F in the winter. The monthly mean temperature ranges from about 69°F in July to about 27°F in January. The area experiences about 10 days per year with maximum temperatures exceeding 90°F and about 12 days per year with minimum temperatures of 0°F or below. The area is occasionally affected by warm Chinook winds blowing down the slopes of the Laramie Mountains 30 miles to the west of Cheyenne. This effect is most frequently noticeable during the winter months (U.S. Department of Commerce 1982).

The prevailing winds are from the west to west-northwest. A joint frequency distribution of wind direction by wind speed class is provided in Table 2.1-2. Average surface wind speeds are quite high, averaging about 13 miles per hour (mph). Windy days are particularly frequent in the winter and spring months, when monthly mean wind speeds can exceed 15 mph. Minimum monthly average wind speeds of about 10.5 mph occur during July and August (U.S. Department of Commerce 1982).

The atmospheric dispersion potential in the area is usually good. The mean morning mixing depth, measured at 5:00 AM local standard time, is approximately 1,000 feet and the mean afternoon mixing depth, calculated for 5:00 PM local standard time, is approximately 8,000 feet (Holzworth 1972). More recent data from the Wyoming Department of Environmental Quality (WDEQ) (1983a) indicate the mean afternoon mixing depth to be 6,600 feet; this more conservative value is used in the subsequent air quality analysis. Surface-based inversions occur about 40 percent of the time, primarily during nighttime hours (Hosler 1961). The atmospheric stability is generally neutral to slightly stable 82 percent of the time (WDEQ 1982a).

2.1.2 Regional Emissions

The latest annual (1980) regional air quality emission inventory (by county), extracted from the United States Environmental Protection Agency (EPA) National Emission Data System, is provided in Table 2.1-3. Emission data were



LOCATION OF METEOROLOGICAL STATIONS AND AIR QUALITY MONITORING STATIONS

FIGURE NO. 2.1-1

Table 2.1-1

SUMMARY OF MONTHLY PRECIPITATION DATA
CHEYENNE, WYOMING

Month	Precipitation (Normals) (inches)
January	0.46
February	0.46
March	1.05
April	1.57
May	2.52
June	2.41
July	1.82
August	1.45
September	1.03
October	0.95
November	0.58
December	0.35
Annual	14.65

Period of Record: 1941-1970.

Source: U.S. Department of Commerce 1982.

Table 2.1-2

JOINT FREQUENCY DISTRIBUTION OF WIND DIRECTION AND WIND SPEED - CHEYENNE, WYOMING[1]

Wind Direction	Wind Speed (mi/hr) 0 - 4	5 - 7	8 - 12	13 - 18	19 - 24	Greater Than 24	Total (Percent)
	Frequency Distribution (Percent)						
N	0.19	0.58	1.58	2.34	1.51	0.99	7.20
NNE	0.15	0.47	1.17	1.70	0.80	0.28	4.57
NE	0.15	0.53	0.89	0.97	0.26	0.05	2.86
ENE	0.12	0.48	0.81	0.46	0.09	0.00	1.96
E	0.16	0.47	0.74	0.36	0.04	0.00	1.77
ESE	0.17	0.47	0.94	0.57	0.12	0.00	2.27
SE	0.14	0.51	0.86	0.77	0.12	0.01	2.43
SSE	0.13	0.52	1.29	1.55	0.27	0.02	3.79
S	0.21	0.73	1.99	2.04	0.38	0.01	5.35
SSW	0.18	0.73	2.04	2.16	0.38	0.02	5.50
SW	0.31	1.39	2.83	1.51	0.14	0.01	6.19
WSW	0.33	1.54	2.92	1.48	0.31	0.11	6.70
W	0.40	1.70	3.44	2.40	1.21	0.65	9.80
WNW	0.42	1.89	6.55	7.43	3.40	2.95	22.64
NW	0.19	0.74	1.88	2.97	2.15	2.24	10.16
NNW	0.13	0.51	1.35	2.40	1.44	0.82	6.66

1 Period of Record, 1960 - 1964 (Wyoming Department of Environmental Quality 1982a)

Table 2.1-3

REGIONAL AIR QUALITY INVENTORY (1980)

	Emission Source (T/Year)																			
	Fuel Combustion					Industrial Process					Solid Waste Disposal					Air/Water Transportation				
County (State)	TSP	SO_x	NO_x	CO	VOC[1]	TSP	SO_x	NO_x	CO	VOC[1]	TSP	SO_x	NO_x	CO	VOC[1]	TSP	SO_x	NO_x	CO	VOC[1]
Laramie (WY)	433	5,337	7,684	1,194	1,907	601	2,825	540	280	1,380	321	24	47	2,052	690	61	11	97	649	147
Platte (WY)	193	3,215	10,034	301	35	19	0	0	0	0	41	2	8	199	65	0	0	2	202	39
Goshen (WY)	114	1,162	1,374	355	398	95	14	6	0	0	52	4	12	248	82	0	0	1	79	10
Kimball (NE)	0	4	23	4	3	162	0	0	0	0	20	1	4	109	35	0	0	1	71	5
Banner (NE)	0	1	4	0	0	0	0	0	0	0	1	0	0	8	3	0	0	0	3	0
Scotts Bluff (NE)	383	138	717	239	64	339	203	74	4,454	46	98	3	17	567	185	1	0	5	401	67

	Land Transportation					Miscellaneous (Primarily Fugitive Dust)					Total				
	TSP	SO_x	NO_x	CO	VOC[1]	TSP	SO_x	NO_x	CO	VOC[1]	TSP	SO_x	NO_x	CO	VOC[1]
Laramie (WY)	3,723	1,078	9,230	67,519	6,723	39,147	1	32	1,125	1,533	44,286	9,276	17,630	72,819	12,380
Platte (WY)	407	237	2,283	8,747	1,119	13,561	1	23	826	320	14,221	3,455	12,350	10,275	1,578
Goshen (WY)	680	309	3,151	13,204	1,527	13,557	1	25	881	305	14,498	1,490	4,569	14,767	2,322
Kimball (NE)	158	38	493	4,730	479	11,038	0	9	312	219	11,378	43	530	5,226	741
Banner (NE)	38	10	136	1,050	107	5,114	0	7	237	53	5,153	11	147	1,298	163
Scotts Bluff (NE)	881	195	2,196	21,217	1,903	13,772	0	8	273	1,049	15,474	589	3,017	27,151	3,314

Note: [1] VOC = Volatile Organic Compounds are a measure of reactive hydrocarbons.

Source: EPA Annual Report, National Emission Data System (EPA 1983a).

available for total suspended particulates, oxides of sulfur, oxides of nitrogen, carbon monoxide (CO), and volatile organic compounds, a measure of hydrocarbons.

The data include the four most important source categories, namely fuel combustion in stationary sources, transportation, solid waste disposal, and industrial processes, as well as a fifth source category, miscellaneous. Stationary fuel combustion sources include both area sources and point sources of fuel used for heat and power in residences, industries, institutions, and commercial buildings. The transportation category includes automobiles, trucks, buses, aircraft, trains, and water transportation vessels. Solid waste disposal emissions include those from all sources of open burning and incineration, while emissions from industrial processes include only those industrial air pollutants emitted during the manufacturing process. Miscellaneous emissions types vary according to the region involved, but most commonly include fugitive dust, solvent evaporation, agricultural burning, forest fires, and structural fires.

Based on the air quality inventory, emissions of oxides of nitrogen, CO, and hydrocarbons derive primarily from transportation-related sources. Evaporation of petroleum products and solvents is an additional source of hydrocarbons. Electrical generation is an additional source of oxides of nitrogen. Emissions of oxides of sulfur are mostly from coal and oil combustion and petroleum industry processes. Total suspended particulate emissions occur primarily as fugitive dust resulting from vehicular traffic on unpaved roads. Existing major point sources of air pollutants include the Husky Oil Refinery, the Wycon Chemical Fertilizer Plant, the Morrison-Knudsen Quarry, and the F.E. Warren AFB Central Heating Plant, which are all located in Laramie County and the Laramie River Power Station in Platte County.

2.2 Project Requirements

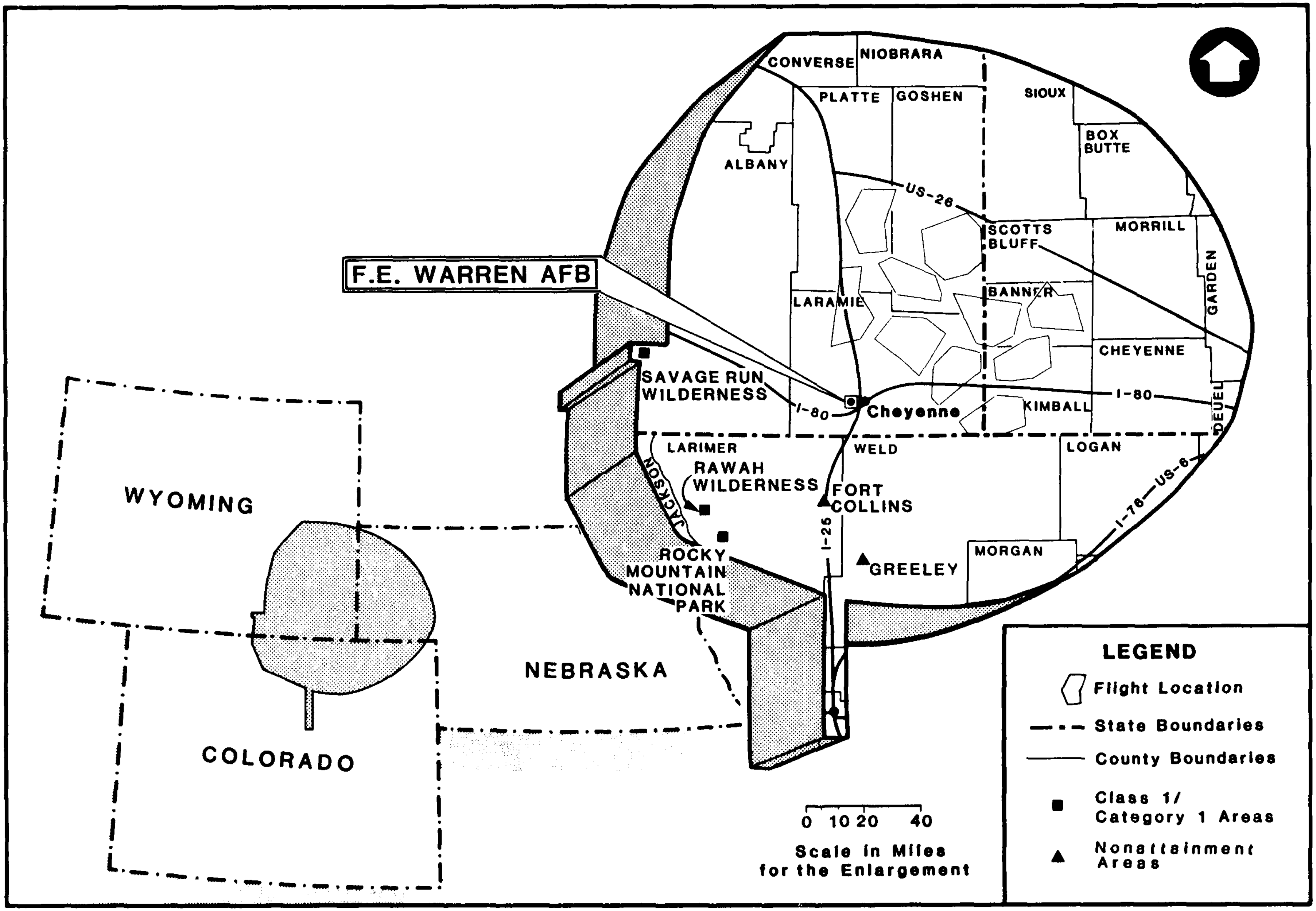
Overall project requirements are outlined in Section 1.1.

2.3 Region of Influence

2.3.1 Definition

The Region of Influence (ROI) for the air quality analysis includes those surrounding areas in which air quality may be affected directly (by construction activities) or indirectly (by project-induced transportation traffic and housing development). It centers on F.E. Warren AFB, the city of Cheyenne, interstate highways, principal traffic arterials, and affected silos, access roads, and cable trench paths within the DA. Outer boundaries of the ROI were conservatively set at 50 miles from the pollution sources.

In addition, the ROI includes federal and state-mandated areas of study, nearby nonattainment areas (Fort Collins and Greeley, Colorado), nearby federal Prevention of Significant Deterioration Class I areas (Rocky Mountain National Park and Rawah Wilderness, Colorado), and nearby state Category I areas (Savage Run Wilderness, Wyoming). The total ROI for air quality is presented in Figure 2.3-1.



REGION OF INFLUENCE FOR AIR QUALITY

FIGURE NO 2.3-1

An Area of Concentrated Study (ACS) within the ROI includes F.E. Warren AFB; Cheyenne, Wheatland, and Chugwater, Wyoming; Kimball, Nebraska; and areas where pollutant concentrations are expected to exceed minimum threshold levels. A more detailed description and justification of the ACS is provided in Section 3.0.

2.3.2 Justification

The ROI is based upon EPA minimum levels for air quality impacts (Federal Register 1978). The source of air pollution is defined as the "envelope" containing all of the sites of construction activity and the principal traffic routes.

The ROI boundary is determined for each analyzed pollutant. It is defined as the distance from any point on the circumference of that pollution source envelope, equivalent to the maximum distance from a pollution source to a location at which minimum threshold increment concentrations are indicated (EPA Area of Impact criteria) (EPA 1980a). This distance is predicted by dispersion modeling.

Study area classifications (nonattainment, Prevention of Significant Deterioration Class I, and Prevention of Significant Deterioration Category I) are determined by the EPA, the WDEQ, the Nebraska Department of Environmental Control (NDEC), and the Colorado Department of Health (CDH). Nonattainment areas are those areas which have been designated as exceeding one or more of the ambient air quality standards. Mandatory Class I/Category I areas are those areas where practically no deterioration of air quality is allowed. These areas include international parks, national wilderness areas, memorial parks larger than 5,000 acres, and national parks larger than 6,000 acres. Deterioration of air quality includes increases in atmospheric concentrations of pollutants and impairment of visibility within a reasonable distance from the source(s) of atmospheric emissions (Federal Register 1980, WDEQ 1982b, NDEC 1982a, CDH 1982a).

2.3.2.1 Carbon Monoxide

CO is a localized pollutant associated with operation of motor vehicles. Since CO is rapidly dispersed into the atmosphere following emission from a source, the ROI for this pollutant comprises a linear "envelope" parallel to major roadways conveying project-related traffic during both the construction and operation phases of the project.

2.3.2.2 Fugitive Dust

Fugitive dust emissions, which are airborne particles resulting from wind passing over unstabilized surfaces, tend to be larger in their area of influence, and are dependent upon wind speed and specific particle sizes and densities. The ROI for this pollutant is an "envelope" whose edges lie no farther than 50 miles from any point on the circumference of the pollution source.

2.3.2.3 Visibility

The impairment of visibility generally results from either aerosol pollutants or particulate matter (i.e., fugitive dust) in an airborne state. The visibility ROI incorporates the closest nonattainment, federal Class I, and state Category I areas.

2.4 Derivation of Data Base

2.4.1 Literature Sources

Numerous documents and reports were used in the preparation of text and evaluation of analytic techniques. These sources are referenced throughout the text and listed in Section 5.0.

2.4.2 Groups and Agency Contacts

Information and data relevant to all aspects of the air quality analysis have been acquired from the following sources:

EPA, Region VIII, Air Branch

EPA, Region VII, Air Branch

EPA, Office of Air Quality Planning and Standards

U.S. Department of Commerce, National Climatic Data Center

U.S. Department of Commerce, National Weather Service

U.S. Department of Agriculture, Forest Service

U.S. Department of Agriculture, Soil Conservation Service

U.S. Department of the Interior, Bureau of Land Management

U.S. Department of the Interior, National Park Service

U.S. Department of Transportation, Federal Highway Administration

Wyoming Department of Environmental Quality, Air Quality Division

Wyoming State Highway Department, Environmental Services

Nebraska Department of Environmental Control, Air Division

Nebraska Department of Roads, Project Development Division

Colorado Department of Health, Air Pollution Control Division

City of Cheyenne, Zoning Department

City of Cheyenne, Engineering Department

City of Cheyenne, Planning Department

Town of Torrington, Local Municipal Officials

Town of Wheatland, Local Municipal Officials

City of Kimball, Local Municipal Officials

City of Scottsbluff, Local Municipal Officials

City of Gering, Local Municipal Officials

Midwest Research Institute

2.4.3 Primary Data

Since existing air quality monitoring programs operated by the states of Wyoming, Nebraska, and Colorado were considered adequate for determination of background air quality, no site-specific air quality monitoring program was conducted for this study.

2.5 Analytic Methods for Existing Conditions

The selection of specific models and methodologies for assessing environmental air quality is dependent upon the following criteria:

- o Scale and time duration of the project;
- o Geophysical conditions of the project area;
- o Determination of pollution sources;
- o Level of assessment; and
- o Regulatory agency coordination.

The scale of a project is used to determine the anticipated range of the area potentially impacted and, hence, the type of model to be employed. With projects of large magnitude, such as Peacekeeper, which involve a variety of impact sources, one would employ a range of model types in order to determine both local and regional impacts.

The geophysical conditions of the project area are important to model selection since various air quality models have been developed for use in areas having specific topography and meteorology. The models selected for use in this report were developed for use in areas of level terrain and high altitude and/or were adjusted to reflect general meteorological conditions for the ROI.

The determination of pollution sources is a function of the type of activity associated with the specific project to be assessed, and in turn, affects the type of assessment model to be employed. Construction projects involving surface disturbance of land areas typically produce increases in fugitive dust emissions. The scale of the construction activity affects the degree of fugitive dust impacts and, hence, whether the impacts would be of short or long duration. Large construction projects also typically result in increased vehicular traffic on area roadways from construction vehicles, workforce commuter traffic, and project-induced population increases.

The level of assessment desired for impact evaluation is also critical in model selection. It is often desirable to screen specific impact areas with a conservative yet simple model to determine the potential impacts. When conservative screening models indicate unrealistically high impacts, further analysis is usually performed with more accurate and realistic models and assumptions.

The final factor, regulatory agency coordination, is also important in model selection. Coordination with federal, state, and local regulatory agencies may indicate agency preference for one model versus another. As a result of this type of coordination in the present study, the State of Wyoming stated a preference for its version of the Climatological Dispersion Model - Wyoming which was used to determine annual fugitive dust impacts (WDEQ 1983a). The EPA Region VIII Office stated preference for the Industrial Source Complex - Short Term model which has been used to determine project-related 24-hour fugitive dust impacts (EPA 1983b).

These criteria have been used in the selection of the appropriate analytic methods for assessing both the existing air quality and the future air quality associated with the Proposed Action, project element alternatives, and the No Action Alternative.

2.5.1 Carbon Monoxide

CO is the primary pollutant associated with transportation sources and, hence, tends to be a unique problem for urban areas. In order to determine vehicular CO concentrations on selected roadway segments and intersections, the EPA mobile source emissions program, MOBILE 2 (EPA 1981a), was used in conjunction with the CALINE 3 dispersion model (Federal Highway Administration 1979).

2.5.1.1 MOBILE 2

The EPA's computerized mobile source emissions program, MOBILE 2, was used to determine composite vehicular emission source strengths for CO. Specific vehicular mixes (i.e., percentages of light-duty gas/diesel cars and trucks, medium-duty gas/diesel trucks, and heavy-duty gas/diesel trucks), percent hot or cold start operations, inspection/maintenance criteria, and ambient temperature were incorporated into the program. This model is an accepted EPA procedure for emissions development.

The emission factors obtained from MOBILE 2 were input into the CALINE 3 model to represent actual and projected future CO emissions along selected roadway corridors and intersections. A listing of these selected roadway segments (corridors) and intersections along with their associated traffic volumes, speeds, and emission factors is shown in Table 2.5-1.

Additional detailed discussion of this model is provided in Appendix A, while detailed discussions of model inputs appear in Appendix B.

Table 2.5-1

1983 CALCULATED TRAFFIC COLUMES, SPEEDS, AND EMISSION FACTORS FOR SELECTED ROADWAYS AND INTERSECTIONS

Roadway Configuration	Link	Volumes (Number of vehicles per hour)		Speeds (mph)		Carbon Monoxide Emissions (grams/mile)	
		1-hr Analysis	8-hr Analysis	1-hr Analysis	8-hr Analysis	1-hr Analysis	8-hr Analysis
Roadway Segments							
Cheyenne, Wyoming							
Interstate 25 (Central Avenue to Pershing Boulevard)	Northbound	900	630	55	55	41	37
	Southbound	600	420	55	55	41	37
Interstate 25 (Pershing Boulevard to Missile Drive)	Northbound	660	385	55	55	41	37
	Southbound	440	385	55	55	41	37
Interstate 25 (Missile Drive to Interstate 80)	Northbound	660	385	55	55	41	37
	Southbound	440	385	55	55	41	37
Interstate 25 (Interstate 80 to College Drive)	Northbound	660	385	55	55	41	37
	Southbound	440	385	55	55	41	37
Interstate 80 (Interstate 25 to Interstate 180)	Eastbound	280	210	55	55	42	40
	Westbound	420	210	55	55	42	40
Interstate 80 (Interstate 180 to College Drive)	Eastbound	260	228	55	55	42	40
	Westbound	390	228	55	55	42	40
College Drive (Interstate 25 to Parsley Boulevard)	Two-Way	400	280	40	40	66	46

Table 2.5-1 Continued, Page 2 of 5
1983 CALCULATED TRAFFIC VOLUMES, SPEEDS, AND EMISSION FACTORS FOR SELECTED ROADWAYS AND INTERSECTIONS

		Volumes (Number of vehicles per hour)		Speeds (mph)		Carbon Monoxide Emissions (grams/mile)	
Roadway Configuration	Link	1-hr Analysis	8-hr Analysis	1-hr Analysis	8-hr Analysis	1-hr Analysis	8-hr Analysis
Roadway Segments							
College Drive (Parsley Boulevard to Walterscheid Boulevard)	Two-Way	500	350	40	40	66	46
College Drive (Walterscheid Boulevard to U.S. 85)	Two-Way	500	350	40	40	66	46
Missile Drive (Interstate 25 to 20th Street)	Two-Way	650	455	30	30	86	60
Ames Avenue (Parsley Boulevard to 20th Street)	Two-Way	1,150	805	30	30	86	60
Lincolnway (Pershing Boulevard to Ridge Road)	Two-Way	800	560	45	45	64	45
Windmill Road (Dell Range Boulevard to Pershing Boulevard)	Two-Way	650	455	40	40	66	46
Ridge Road (Four Mile Road to Dell Range Boulevard)	Two-Way	900	630	30	30	86	60

Table 2.5-1 Continued, Page 3 of 5
1983 CALCULATED TRAFFIC VOLUMES, SPEEDS, AND
EMISSION FACTORS FOR SELECTED ROADWAYS
AND INTERSECTIONS

Roadway Configuration	Link	Volumes (Number of vehicles per hour) 1-hr Analysis	Volumes (Number of vehicles per hour) 8-hr Analysis	Speeds (mph) 1-hr Analysis	Speeds (mph) 8-hr Analysis	Carbon Monoxide Emissions (grams/mile) 1-hr Analysis	Carbon Monoxide Emissions (grams/mile) 8-hr Analysis
Roadway Segments							
Prairie Avenue (Yellowstone Road to Dell Range Boulevard)	Two-Way	1,100	770	30	30	86	60
Central Avenue (Interstate 25 to Yellowstone Road)	Two-Way	1,400	980	30	30	86	60
Intersections							
Cheyenne, Wyoming							
16th Street and	Eastbound	2,050	1,435	10	15	188	98
	Westbound	1,300	910	10	15	188	98
Warren Avenue	Northbound	900	630	10	15	188	98
	Southbound	810	567	10	15	188	98
Pershing Boulevard and	Eastbound	1,150	805	10	15	188	98
	Westbound	950	665	10	15	188	98
Central Avenue	Northbound	900	630	10	15	188	98
	Southbound	900	630	10	15	188	98
Pershing Boulevard and	Eastbound	1,400	980	10	15	188	98
	Westbound	1,150	805	10	15	188	98
Warren Avenue	Northbound	900	630	10	15	188	98
	Southbound	900	630	10	15	188	98

Table 2.5-1 Continued, Page 4 of 5
1983 CALCULATED TRAFFIC VOLUMES, SPEEDS, AND
EMISSION FACTORS FOR SELECTED ROADWAYS
AND INTERSECTIONS

		Volumes (Number of vehicles per hour)		Speeds (mph)		Carbon Monoxide Emissions (grams/mile)	
Roadway Configuration	Link	1-hr Analysis	8-hr Analysis	1-hr Analysis	8-hr Analysis	1-hr Analysis	8-hr Analysis
Intersections							
Yellowstone Road	Northbound	1,200	840	10	15	188	98
and	Southbound	2,300	1,610	10	15	188	98
Prairie Avenue	Eastbound	1,150	805	10	15	188	98
Pershing Boulevard	Eastbound	800	560	10	15	188	98
and	Westbound Ramp	465	258	10	15	188	98
	AFB Entrance	465	258	10	15	188	98
	Eastbound Ramp 1	320	265	10	15	188	98
	Eastbound Ramp 2	320	265	10	15	188	98
Randall Avenue	Eastbound Ramp	300	210	10	15	188	98
	Westbound	450	315	10	15	188	98
Pershing Boulevard	Eastbound	1,400	980	10	15	188	98
and	Westbound	1,300	910	10	15	188	98
Converse Avenue	Northbound	1,050	735	10	15	188	98
	Southbound	1,050	735	10	15	188	98
20th Street	Eastbound	750	525	10	15	188	98
and	Westbound	750	525	10	15	188	98
Warren Avenue	Northbound	800	560	10	15	188	98
	Southbound	800	560	10	15	188	98

Table 2.5-1 Continued, Page 5 of 5
1983 CALCULATED TRAFFIC VOLUMES, SPEEDS, AND EMISSION FACTORS FOR SELECTED ROADWAYS AND INTERSECTIONS

Roadway Configuration	Link	Volumes (Number of vehicles per hour)		Speeds (mph)		Carbon Monoxide Emissions (grams/mile)	
		1-hr Analysis	8-hr Analysis	1-hr Analysis	8-hr Analysis	1-hr Analysis	8-hr Analysis
Intersections							
Dell Range Boulevard	Eastbound	750	911	10	15	188	98
and	Westbound	750	760	10	15	188	98
Ridge Road	Northbound	750	574	10	15	188	98
	Southbound	900	574	10	15	188	96
Kimball, Nebraska							
Route 71 and	Northbound	284	207	10	15	189	100
	Southbound	284	207	10	15	189	100
U.S. 30	Eastbound	476	346	10	15	189	100
	Westbound	476	346	10	15	189	100
Wheatland, Wyoming							
16th Street	Northbound	906	659	10	15	189	100
and	Southbound	906	659	10	15	189	100
South Street	Eastbound	1,230	895	10	15	189	100
	Westbound	1,230	895	10	15	189	100

2.5.1.2 CALINE 3

The computerized CALINE 3 model is a Gaussian diffusion program used for the estimation of CO concentrations from line (i.e., roadway) sources. The model incorporates vehicular emission factors from MOBILE 2, vehicular volumes, meteorological parameters (i.e., wind speed and direction and atmospheric stability class), and roadway configuration (based upon a Cartesian coordinate system) to estimate 1-hour and 8-hour CO concentrations for selected signed or signaled intersections (interrupted flow) and freely flowing roadway segments (uninterrupted flow). Taking the most conservative approach, worst-case meteorological parameters are used in the analysis. These include the wind direction yielding the highest CO concentration at a receptor, 1 meter per second (m/sec) and 2 m/sec wind speeds for the 1-hour and 8-hour analysis, respectively, and atmospheric stability Class 5 (slightly stable) and Class 4 (neutral) for the 1-hour and 8-hour analysis, respectively. This model is an accepted EPA procedure for mobile source dispersion analysis.

Sensitivity tests were performed for the selected intersections and roadway segments in the project area where high volumes of traffic and/or increases in volumes were anticipated in order to determine the wind angle which would produce maximum CO levels at the designated receptor locations. Receptors were located along the roadway rights-of-way to determine maximum levels associated with human exposure. Roadways were sensitivity-modeled as infinite links to include impacts at the theoretical receptors from distant sources. Highway links were set at 2 miles in length since sensitivity tests indicated that vehicular sources beyond 2 miles had no impact at the receptors. The assigned link lengths for residential roadways were slightly longer than the actual link lengths to approximate the impact of vehicular emissions along adjacent roadway links.

Additional detailed description of this model is included in Appendix A, while detailed discussions of model inputs appear in Appendix B.

2.5.2 Fugitive Dust

In the ROI, fugitive dust emissions comprise the largest component of total suspended particulate matter which becomes airborne due to forces of wind, man's activity, or both. Existing levels of total suspended particulates are determined from review of monitored data collected by the WDEQ, the NDEC, and the CDH. Monitored measurements of total suspended particulates at representative rural sites are used to define existing concentrations of fugitive dust in the DA.

2.5.3 Visibility

Existing levels of regional visibility were based on visual range distance, which is the most commonly measured or observed visibility index, determined from review of existing documentation (EPA 1980b).

2.6 Existing Environmental Conditions

The project area lies within the Metropolitan Cheyenne and Nebraska Intrastate Air Quality Control Regions (Code of Federal Regulations 1982). These regions are classified as attainment areas with respect to state and federal air quality standards. The closest nonattainment areas, Greeley and Fort Collins, Colorado, are approximately 50 miles south and 40 miles south-southwest, respectively, of Cheyenne, Wyoming as shown in Figure 2.3-1. Both Greeley and Fort Collins are designated nonattainment for the primary 8-hour CO standard and the secondary annual total suspended particulate standard (CDH 1982b). The closest Prevention of Significant Deterioration Class I areas, Rocky Mountain National Park and Rawah Wilderness (Colorado), are located approximately 60 miles southwest and south-southwest, respectively, from Cheyenne as shown in Figure 2.3-1. The closest state (Wyoming) Category I area, Savage Run Wilderness, is located approximately 80 miles west of Cheyenne as shown in Figure 2.3-1.

The project area currently experiences excellent air quality, due to the following conditions favorable for atmospheric dispersion of air pollutants: neutral atmospheric stability, extensive mixing heights, high wind speed, and relatively few sources of air pollutants in the immediate area.

Air pollutants in the regional and local area are monitored by the WDEQ, Air Quality Division; NDEC, Air Division; and CDH, Air Pollution Control Division. Locations of monitoring stations in the ROI are shown in Figure 2.1-1. Pollutant concentrations at these stations have been summarized by the State agencies in their annual air quality reports.

Based on 1982 air quality measurements in Cheyenne, the annual average concentration of sulfur dioxide was less than 1 microgram per cubic meter (ug/m^3), which is almost negligible compared to the Wyoming Ambient Air Quality Standard of 60 ug/m^3, and the Nebraska and National Ambient Air Quality Standard of 80 ug/m^3. The annual average nitrogen dioxide concentration was 23 ug/m^3, compared to the National, Wyoming, and Nebraska Ambient Air Quality Standard of 100 ug/m^3. No exceedances of State or National standards for sulfur dioxide and nitrogen dioxide were recorded between 1980 and 1982.

2.6.1 Carbon Monoxide

Key roadway intersections and roadway segments in the project area were selected for evaluation on the basis of present and projected vehicular volumes. These generally included roadway segments which are projected to have 10 percent or greater project-related increases in traffic volumes. A total of 16 roadway segments (corridors) and 10 intersections in the project area (listed in Table 2.6-1) were modeled using CALINE 3. The roadway networks for Cheyenne and Wheatland, Wyoming and Kimball, Nebraska are provided in Figures 2.6-1, 2.6-2, and 2.6-3, respectively. For both the intersection and roadway segment analysis, CO concentrations were predicted for adjacent receptors representing sidewalk locations on or near the edge of pavement. Intersections typically represent the locations of highest CO concentrations, since the relationship between vehicular speed and emissions of CO is such that CO emissions are greatest at low speeds and are maximized during deceleration, idling, and acceleration modes. These operational modes are characteristic of signed or signalized intersections.

Since no monitored CO data were available in the project area, CO background concentrations were determined through coordination with state environmental agencies (WDEQ 1983a, NDEC 1983a). Background levels are defined as those residual levels of a pollutant that are present in the project area exclusive

Table 2.6-1

ROADWAY INTERSECTIONS AND SEGMENTS
ASSESSED FOR CO CONCENTRATIONS

Roadway Segments
Cheyenne, Wyoming

- Interstate 25
  - Central Avenue to Pershing Boulevard
  - Pershing Boulevard to Missile Drive
  - Missile Drive to Interstate 80
  - Interstate 80 to College Drive
- Interstate 80
  - Interstate 25 to Interstate 180
  - Interstate 180 to College Drive
- College Drive
  - Interstate 25 to Parsley Boulevard
  - Parsley Boulevard to Walterscheid Boulevard
  - Walterscheid Boulevard to U.S. 85
- Missile Drive
  - Interstate 25 to 20th Street
- Ames Avenue
  - Parsley Boulevard to 20th Street
- Lincolnway
  - Pershing Boulevard to Ridge Road
- Windmill Road
  - Dell Range Boulevard to Pershing Boulevard
- Ridge Road
  - Four Mile Road to Dell Range Boulevard
- Prairie Avenue
  - Yellowstone Road to Dell Range Boulevard
- Central Avenue
  - Interstate 25 to Yellowstone Road

Intersections
Cheyenne, Wyoming

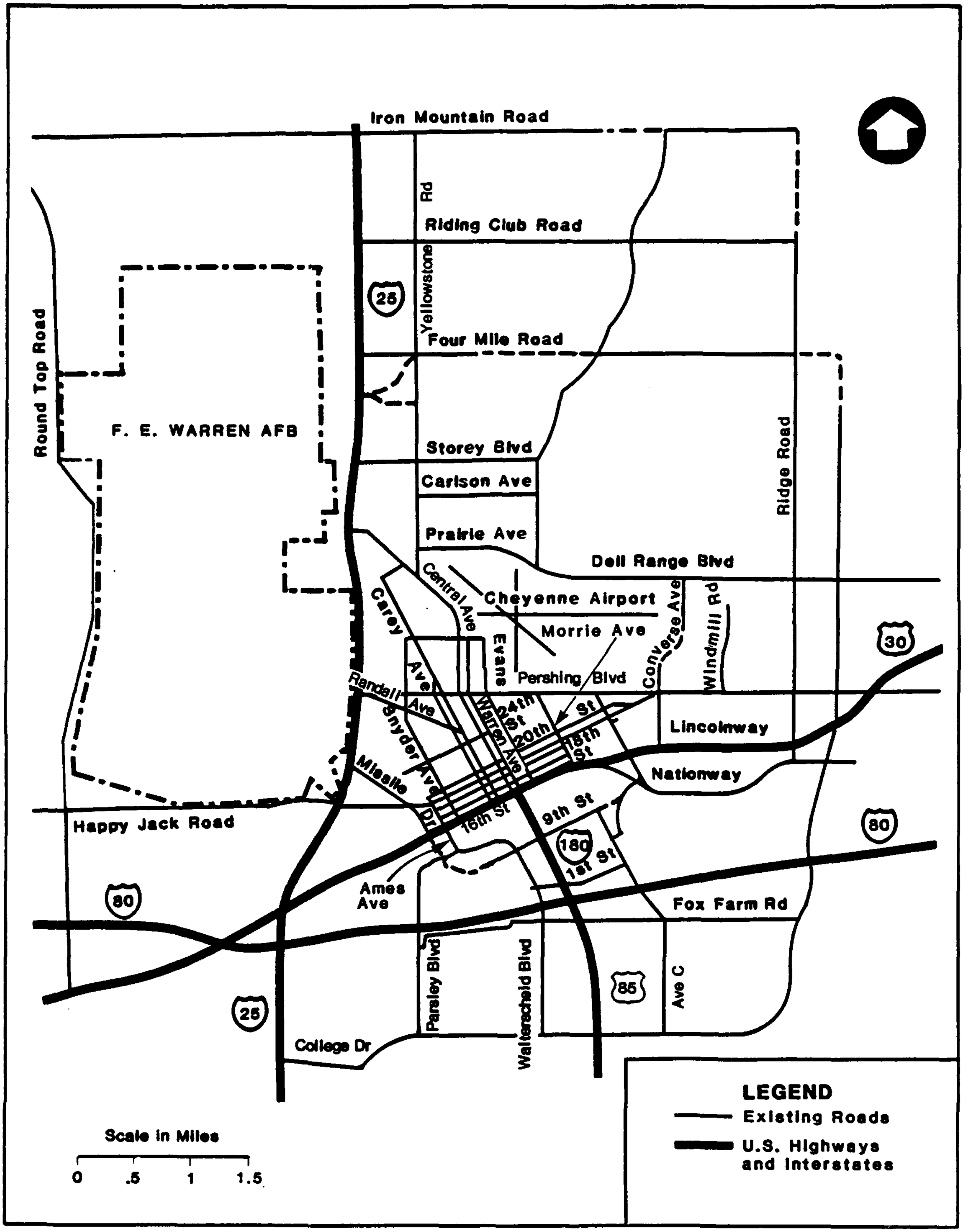
- 16th Street/Warren Avenue
- Pershing Boulevard/Central Avenue
- Pershing Boulevard/Warren Avenue
- Yellowstone Road/Prairie Avenue
- Pershing Boulevard/Randall Avenue
- Pershing Boulevard/Converse Avenue
- 20th Street/Warren Avenue
- Dell Range Boulevard/Ridge Road

Kimball, Nebraska

Route 71/U.S. 30

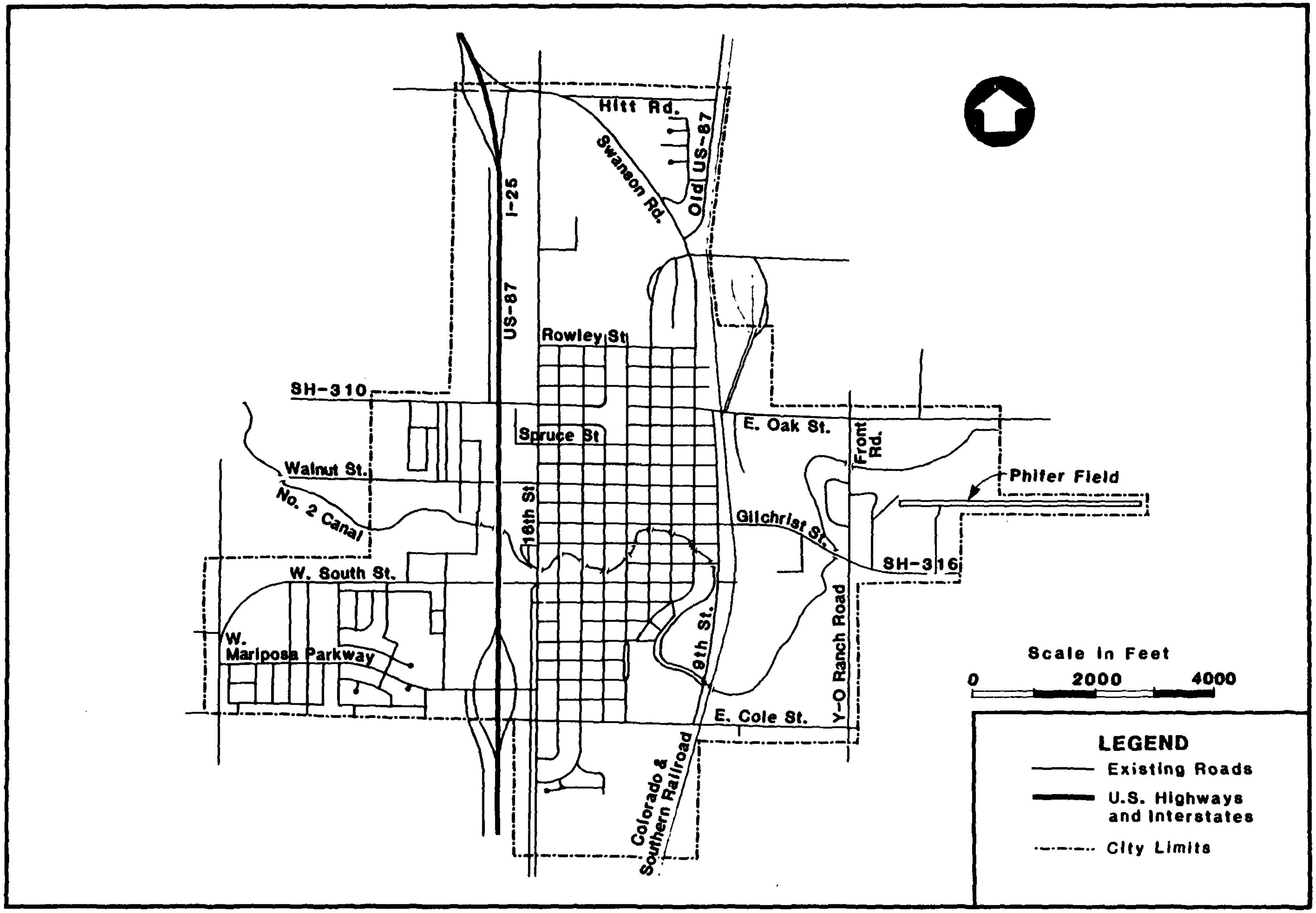
Wheatland, Wyoming

16th Street/South Street



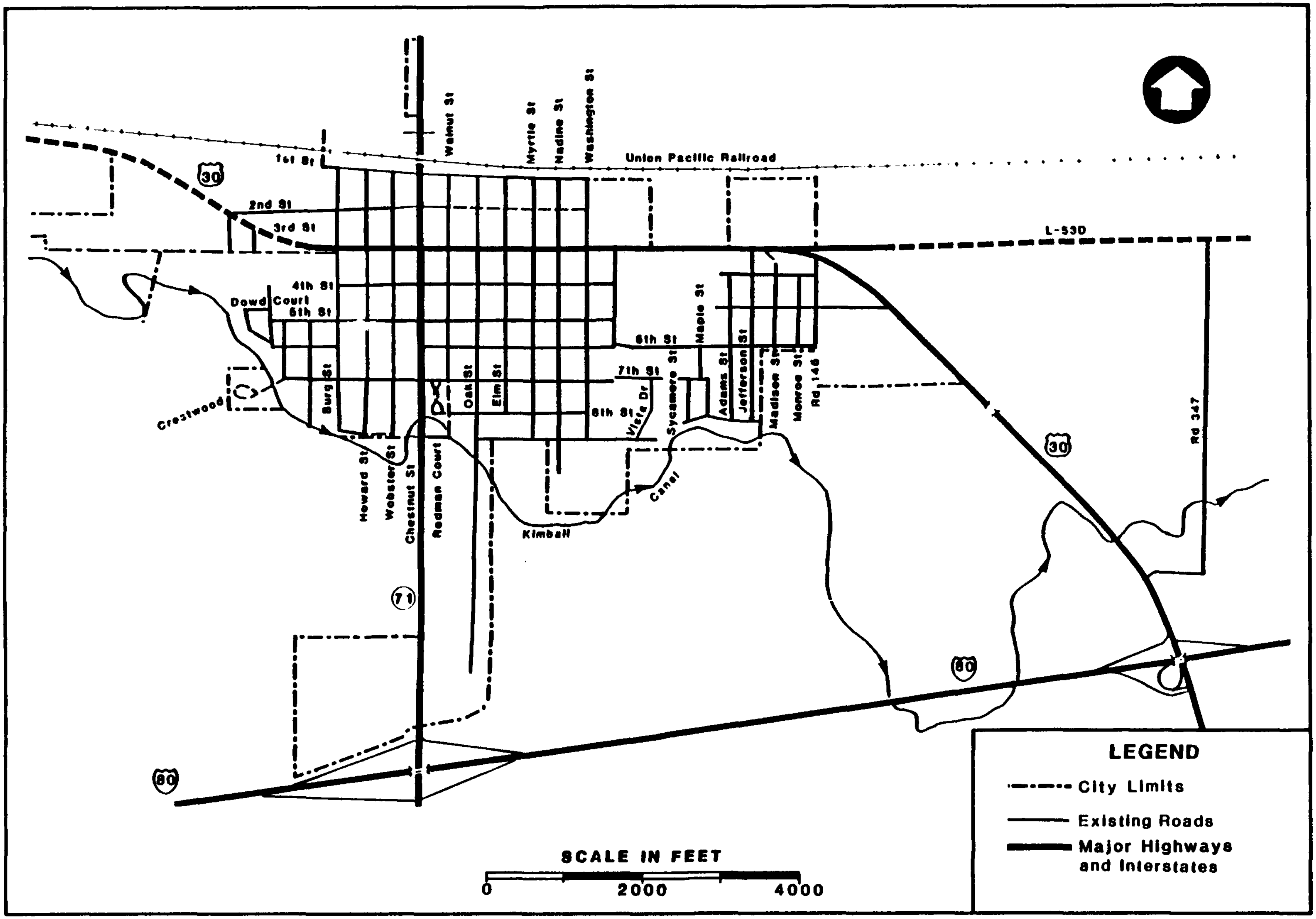
CHEYENNE, WYOMING,
ROADWAY NETWORK

FIGURE NO. 2.6-1



WHEATLAND, WYOMING, ROADWAY NETWORK

FIGURE NO. 2.6-2



KIMBALL, NEBRASKA, ROADWAY NETWORK

FIGURE NO. 2.6-3

of the roadway(s) under study, and are added to predicted levels in order to determine total CO concentrations. Values of 1.0 part per million (ppm) for 1 hour and 0.5 ppm for 8 hours have been used in this report. These values were added to the respective 1-hour and 8-hour concentrations of CO predicted from the CALINE 3 modeling.

The results of the CALINE 3 roadway segment and intersection analysis for the base year, 1983, are provided in Table 2.6-2. The highest concentrations are predicted at intersections since CO emissions increase as vehicular speeds decrease. The intersection of Yellowstone Road and Prairie Avenue is predicted to have the highest CO concentrations. The predicted 1-hour concentration is 30.3 ppm, while the 8-hour concentration is 5.7 ppm. The highest predicted 1-hour concentration along a roadway segment is 9.1 ppm along Central Avenue between Interstate 25 and Yellowstone Road. The highest 8-hour concentration is 2.1 ppm along Ames Avenue between Parsley Boulevard and 20th Street. All 1-hour and 8-hour predicted CO concentrations are below applicable ambient air quality standards.

2.6.2 Fugitive Dust

Fugitive dust emissions are airborne particles whose primary sources are disturbed land surfaces from agricultural tilling, piling and uncovered storage of erodible materials, construction activity, and vehicular travel on unpaved roads. They are part of a large grouping known as total suspended particulates which includes particulates from solid waste disposal and incineration, industrial processes, vehicular operation (asbestos from brake wear, rubber from tire wear), and fuel consumption (primarily carbon soot). Fugitive dust emissions have been analyzed in this report since project-related construction activity will increase levels of airborne particulate matter. In this sense, fugitive dust emissions will be used as a measure of the total suspended particulate impacts of the project. The National, Wyoming, and Nebraska Ambient Air Quality Standards address primary and secondary standards of total suspended particulates. The 1980 annual inventory of fugitive dust is provided in Table 2.6-3. This table lists the total suspended particulate emissions, fugitive dust emissions, and the percent of fugitive dust contributions to the total suspended particulate emissions inventory.

The 1982 annual geometric mean total suspended particulate concentration measured in Cheyenne, Wyoming and Scottsbluff, Nebraska was 30 and 67 ug/m^3, respectively. The second highest recorded 24-hour total suspended particulate measurement was 60 and 152 ug/m^3 in Cheyenne and Scottsbluff, respectively. The rural annual geometric mean total suspended particulate concentration considered representative for the DA is 17.5 ug/m^3 (WDEQ 1983a, NDEC 1983a). It should be noted that the measured concentrations most probably include fugitive dust from agricultural activities and from natural windblown surfaces.

Annual and 24-hour measured total suspended particulate concentrations, for the period 1980 to 1982, from air quality monitoring stations within the ROI are provided in Table 2.6-4.

Table 2.6-2

CALCULATED CARBON MONOXIDE CONCENTRATIONS AT SELECTED RECEPTOR LOCATIONS FOR 1983[a]

Roadway Configuration	1-Hour Concen-tration	8-Hour Concen-tration
Roadway Segments	(ppm)	(ppm)
Cheyenne, Wyoming		
Interstate 25 (Central Avenue to Pershing Boulevard)	2.6	0.9
Interstate 25 (Pershing Boulevard to Missile Drive)	2.2	0.8
Interstate 25 (Missile Drive to Interstate 80)	2.2	0.7
Interstate 25 (Interstate 80 to College Drive)	2.2	0.7
Interstate 80 (Interstate 25 to Interstate 180)	1.6	0.7
Interstate 80 (Interstate 180 to College Drive)	1.6	0.7
College Drive (Interstate 25 to Parsley Boulevard)	2.5	0.8
College Drive (Parsley Boulevard to Walterscheid Boulevard)	2.9	0.9
College Drive (Walterscheid Boulevard to U.S. 85)	2.9	0.9
Missile Drive (Interstate 25 to 20th Street)	4.8	1.4
Ames Avenue (Parsley Boulevard to 20th Street)	8.5	2.1
Lincolnway (Pershing Boulevard to Ridge Road)	4.4	1.3

Table 2.6-2, Page 2 of 2
CALCULATED CARBON MONOXIDE CONCENTRATIONS
AT SELECTED RECEPTOR LOCATIONS FOR 1983[a]

Roadway Configuration	1-Hour Concentration (ppm)	8-Hour Concentration (ppm)
Windmill Road (Dell Range Boulevard to Pershing Boulevard)	4.3	1.2
Ridge Road (Four Mile Road to Dell Range Boulevard)	4.6	1.1
Prairie Avenue (Yellowstone Road to Dell Range Boulevard)	7.6	2.0
Central Avenue (Interstate 25 to Yellowstone Road)	9.1	1.8
Intersections		
Cheyenne, Wyoming		
16th Street/Warren Avenue	28.8	5.0
Pershing Boulevard/Central Avenue	20.1	3.9
Pershing Boulevard/Warren Avenue	23.4	4.2
Yellowstone Road/Prairie Avenue	30.3	5.7
Pershing Boulevard/Randall Avenue	9.4	1.9
Pershing Boulevard/Converse Avenue	17.9	2.7
20th Street/Warren Avenue	15.1	3.0
Dell Range Boulevard/Ridge Road	12.5	2.7
Kimball, Nebraska		
Route 71/U.S. 30	7.1	1.3
Wheatland, Wyoming		
16th Street/South Street	21.3	3.8

Notes: [a] Includes 1.0 ppm and 0.5 ppm background carbon monoxide levels for 1 and 8-hour periods, respectively.

Table 2.6-3

FUGITIVE DUST EMISSION INVENTORY-1980

County	Total Suspended Particulates (T/yr)	Fugitive Dust (T/yr)	Percent Fugitive Dust
Wyoming			
Laramie	44,286	39,147	88.4
Platte	14,221	13,561	95.4
Goshen	14,498	13,557	93.5
Nebraska			
Kimball	11,378	11,038	97.0
Banner	5,153	5,114	99.2
Scotts Bluff	15,474	13,772	89.0

Source: EPA Annual Report, National Emission Data System (EPA 1983).

Table 2.6-4

TOTAL SUSPENDED PARTICULATE CONCENTRATIONS

State/Station	Averaging Time	1980 Highest ($\mu g/m^3$)	1980 Second Highest ($\mu g/m^3$)	1981 Highest ($\mu g/m^3$)	1981 Second Highest ($\mu g/m^3$)	1982 Highest ($\mu g/m^3$)	1982 Second Highest ($\mu g/m^3$)
Wyoming							
Cheyenne	24 hour	137	120	96	87	77	60
	Annual	52		40		30	
Wheatland	24 hour	173	133				
	Annual	47					
Lingle	24 hour	181	132				
	Annual	29					
Laramie	24 hour	79	78	86	74	54	47
	Annual	41		36		25	
Douglas	24 hour	87	85	62	60	58	53
	Annual	35		28		21	
Nebraska							
Scottsbluff	24 hour	186	155	155	117	159	152
	Annual	85		64		67	
Colorado							
Fort Collins	24 hour	-	227	-	187	-	192
	Annual	80		65		49	
Greeley	24 hour	-	210	-	227	-	148
	Annual	78		61		52	
Estes Park	24 hour	-	95	-	87	-	51
	Annual	43		35		30	
Loveland	24 hour	-	390	-	184	-	165
	Annual	93		71		51	
Sterling	24 hour	-	182	-	180	-	177
	Annual	86		75		60	
Platteville	24 hour	-	180	-	194	-	213
	Annual	74		70		64	

Source: Wyoming Department of Environmental Quality 1983b, 1982c, 1981.
Nebraska Department of Environmental Control 1983b, 1982b, 1981.
Colorado Department of Health 1983, 1982b, 1981.

2.6.3 Visibility

Visibility in the vicinity of the project area tends to be excellent. The annual frequency of windblown dust restricting visibility to less than 7 miles is 0.2 percent. These conditions occur most frequently during the spring months (Orgill and Sehmel 1975). The WDEQ (1983a) and the NDEC (1983a) indicate greatest visibility impairment potential to exist between November and March. Median yearly visual range tends to be high, approaching an average of 64 miles (EPA 1979a).

ENVIRONMENTAL CONSEQUENCES, MITIGATION MEASURES, AND UNAVOIDABLE IMPACTS

3.0 ENVIRONMENTAL CONSEQUENCES, MITIGATION MEASURES, AND UNAVOIDABLE IMPACTS

The Area of Concentrated Study (ACS) for the Proposed Action, project element alternatives, and the No Action Alternative includes F.E. Warren AFB since the base represents a potential pollutant source for fugitive dust emissions associated with the onbase construction. Cheyenne was included due to project-induced residential development as well as increases in transportation pollutant sources. Kimball, Nebraska and Wheatland, Wyoming were included since they represent the largest project-related increase in vehicular operation outside of the Cheyenne area. Additionally, Kimball is a potential dispatch station site. Chugwater, Wyoming was included since it is a potential location of a dispatch station. Other roadways within the project area which are projected to convey personnel to the various Launch Facilities (LFs) were included since potential increases in vehicular operation could result in additional air quality effects. The ACS also includes those areas where total suspended particulate concentrations exceeded the United States Environmental Protection Agency (EPA) minimum threshold values.

3.1 Analytic Methods

The following sections present the analytic methodologies used in assessing the air quality impact of the Proposed Action, project element alternatives and the No Action Alternative. The project peak construction year, 1985, based on traffic volumes and construction activity, was used to analyze short-term impacts (1986 was used for Kimball, Nebraska and Wheatland, Wyoming). Analysis of long-term impacts was based on 1990, a typical project operations year. Impacts determined for 1985 (1986 for Kimball and Wheatland) will be highest for any of the years of construction (short term). Long-term impacts, for operational years, will be equal to or less than those determined for 1990 due to the projected negligible increases of transportation activity between the project and the No Action Alternative. The No Action Alternative assumes no project and is based on anticipated, normal growth within the proposed project area.

The analytic evaluation concentrates on carbon monoxide (CO) and fugitive dust because these are the only pollutants expected to have large increases in emission quantities for the level of activity associated with the project. The increases in sulfur dioxide, nitrogen dioxide, and hydrocarbons from construction activity and vehicular traffic were determined to be much lower than for CO and fugitive dust, and their impacts are not expected to approach regulatory values. A detailed discussion of future growth and project-related regional emissions is presented in Appendix D.

More detailed discussions of the specific methodologies used in this report are presented in Appendix A.

3.1.1 Carbon Monoxide

As in the assessment of CO for the existing environmental conditions (Section 2.6.1), primary focus has been directed on vehicular sources which account for approximately 90 percent of total CO emissions in the project area.

3.1.1.1 Baseline Future - No Action Alternative

The assessment of CO concentrations at receptors located adjacent to selected roadway intersections and segments resulting from vehicular operation in the project area was undertaken using the computerized Gaussian dispersion model, CALINE 3, in conjunction with vehicular emission factors generated from the EPA's computerized MOBILE 2 mobile source emissions model. These models are discussed in Section 2.5.1. Taking the most conservative approach, worst expected case meteorological conditions have been incorporated into the analysis.

The assessment was performed for those roadway segments and roadway intersections that presently, or are projected to, convey increased traffic volumes. The selection of these roadways was coordinated with the transportation task group and reflects the concerns voiced by various state and local agencies and the public. Projections of vehicular traffic volumes were based upon growth rates developed for Cheyenne and other project areas and can be found in Table 3.1-1.

3.1.1.2 Proposed Action

The analytic approach for assessing the air quality impacts of the project are identical to those noted in Section 3.1.1.1. Projected future traffic volumes due to the project for 1985 and 1990 are presented in Table 3.1-1. They include the project-related volumes in both Cheyenne and other areas.

3.1.2 Fugitive Dust

3.1.2.1 Baseline Future - No Action Alternative

Projected future levels of total suspended particulates were determined from existing monitored data collected by the Wyoming Department of Environmental Quality (WDEQ) and the Nebraska Department of Environmental Control (NDEC). Monitored measurements of total suspended particulates at existing representative rural sites were used to define projected future levels of fugitive dust concentrations in the Deployment Area (DA).

3.1.2.2 Proposed Action

Fugitive dust concentrations were predicted for 24-hour and annual time periods for construction activities at F.E. Warren AFB, the DA, and in Cheyenne (induced residential housing development), as well as for travel on unpaved roads. EPA dispersion modeling computer programs were used. Fugitive dust emissions for input into these models were developed for each source based on emission factors from AP-42 (EPA 1981b) and Wyoming's Guideline for Fugitive Dust Emission Factors (WDEQ 1979). A detailed description of the emission rate calculations is provided in Appendix C. Both surface meteorological data collected at the Cheyenne National Weather Service station and upper air meteorological data collected at the Denver National Weather Service station, for the period 1960 to 1964, were used in this analysis.

Table 3.1-1

PREDICTED TRAFFIC VOLUMES AT SELECTED
ROADWAYS AND INTERSECTIONS
FOR 1985 AND 1990

		Number of Vehicles per Hour					
		1985 (No Action Alternative)		1985 (Proposed Action)		1990 (No Action Alternative/ Proposed Action)	
Roadway Configuration	Link	1-hr Analysis	8-hr Analysis	1-hr Analysis	8-hr Analysis	1-hr Analysis	8-hr Analysis
Roadway Segments							
Cheyenne, Wyoming							
Interstate 25 (Central Avenue to Pershing Boulevard)	Northbound	680	595	790	690	980	858
	Southbound	1,020	595	1,180	690	1,470	858
Interstate 25 (Pershing Boulevard to Missile Drive)	Northbound	680	595	780	676	900	788
	Southbound	1,020	595	1,150	676	1,350	788
Interstate 25 (Missile Drive to Interstate 80)	Northbound	780	455	840	483	1,110	648
	Southbound	520	455	840	483	740	648
Interstate 25 (Interstate 80 to College Drive)	Northbound	780	455	840	483	1,110	648
	Southbound	520	455	540	483	740	648
Interstate 80 (Interstate 25 to Interstate 180)	Eastbound	300	263	320	280	380	333
	Westbound	450	263	480	280	570	333
Interstate 80 (Interstate 180 to College Drive)	Eastbound	280	245	280	245	340	298
	Westbound	420	245	420	245	510	298

Table 3.1-1 Continued, Page 2 of 6
PREDICTED TRAFFIC VOLUMES AT SELECTED ROADWAYS AND INTERSECTIONS FOR 1985 AND 1990

		Number of Vehicles per Hour					
		1985 (No Action Alternative)		1985 (Proposed Action)		1990 (No Action Alternative/ Proposed Action)	
Roadway Configuration	Link	1-hr Analysis	8-hr Analysis	1-hr Analysis	8-hr Analysis	1-hr Analysis	8-hr Analysis
College Drive (Interstate 25 to Parsley Boulevard)	Two-Way	450	315	480	336	600	420
College Drive (Parsley Boulevard to Walterscheid Boulevard)	Two-Way	650	455	740	518	950	665
College Drive (Walterscheid Boulevard to U.S. 85)	Two-Way	700	490	700	490	950	665
Windmill Road (Dell Range Boulevard to Pershing Boulevard)	Two-Way	750	455	910	637	800	560
Ridge Road (Four Mile Road to Dell Range Boulevard)	Two-Way	600	420	750	525	700	490
Prairie Avenue (Yellowstone Road to Dell Range Boulevard)	Two-Way	1,300	910	1,520	1,064	1,650	1,155

Table 3.1-1 Continued, Page 3 of 6
PREDICTED TRAFFIC VOLUMES AT SELECTED ROADWAYS AND INTERSECTIONS FOR 1985 AND 1990

		Number of Vehicles per Hour					
		1985 (No Action Alternative)		1985 (Proposed Action)		1990 (No Action Alternative/ Proposed Action)	
Roadway Configuration	Link	1-hr Analysis	8-hr Analysis	1-hr Analysis	8-hr Analysis	1-hr Analysis	8-hr Analysis
Roadway Segments							
Central Avenue (Interstate 25 to Yellowstone Road)	Two-Way	1,450	1,015	1,740	1,218	1,800	1,260
Missile Drive (Interstate 25 to 20th Street)	Two-Way	750	525	1,050	735	950	665
Ames Avenue (Parsley Boulevard to 20th Street)	Two-Way	1,150	805	1,320	924	1,200	840
Lincolnway (Pershing Boulevard to Ridge Road)	Two-Way	800	560	900	630	1,150	805
Intersections							
Cheyenne, Wyoming							
16th Street and	Eastbound	2,100	1,470	2,240	1,568	2,400	1,680
	Westbound	1,350	945	1,440	1,008	1,450	1,015
Warren Avenue	Northbound	900	630	920	644	950	665
	Southbound	810	567	920	644	840	588

Table 3.1-1 Continued, Page 4 of 6
PREDICTED TRAFFIC VOLUMES AT SELECTED ROADWAYS AND INTERSECTIONS FOR 1985 AND 1990

		Number of Vehicles per Hour					
		1985 (No Action Alternative)		1985 (Proposed Action)		1990 (No Action Alternative/ Proposed Action)	
Roadway Configuration	Link	1-hr Analysis	8-hr Analysis	1-hr Analysis	8-hr Analysis	1-hr Analysis	8-hr Analysis
Intersections							
Pershing Boulevard	Eastbound	1,200	840	1,680	1,176	1,550	1,085
and	Westbound	1,000	700	1,330	931	1,250	875
Central Avenue	Northbound	900	630	900	630	950	665
	Southbound	900	630	900	630	900	630
Pershing Boulevard	Eastbound	1,550	1,085	1,680	1,176	2,100	1,470
and	Westbound	1,200	840	1,330	931	1,550	1,085
Warren Avenue	Northbound	900	630	920	592	950	665
	Southbound	900	630	920	592	1,100	770
Pershing Boulevard	Eastbound	1,700	1,190	1,970	1,379	2,000	1,400
and	Westbound	1,700	1,190	1,970	1,379	1,750	1,225
Converse Avenue	Northbound	1,150	805	1,050	735	1,450	1,015
	Southbound	1,150	805	1,150	805	1,450	1,015
20th Street and	Eastbound	1,100	770	1,240	868	1,100	770
	Westbound	1,100	770	1,240	868	1,100	770
Warren Avenue	Northbound	900	630	920	644	950	665
	Southbound	900	630	920	644	950	665

Table 3.1-1 Continued, Page 5 of 6
PREDICTED TRAFFIC VOLUMES AT SELECTED ROADWAYS AND INTERSECTIONS FOR 1985 AND 1990

		Number of Vehicles per Hour					
		1985 (No Action Alternative)		1985 (Proposed Action)		1990 (No Action Alternative/ Proposed Action)	
Roadway Configuration	Link	1-hr Analysis	8-hr Analysis	1-hr Analysis	8-hr Analysis	1-hr Analysis	8-hr Analysis
Dell Range Boulevard	Eastbound	900	630	910	637	1,350	945
and	Westbound	900	630	910	637	1,350	945
Ridge Road	Northbound	750	525	910	637	1,050	735
	Southbound	600	420	750	525	700	630
Yellowstone Road	Northbound	1,250	875	1,300	910	1,350	945
and	Southbound	2,350	1,645	2,520	1,764	2,500	1,750
Prairie Avenue	Eastbound	1,300	910	1,520	1,064	1,650	1,155
Pershing Boulevard	Eastbound	900	630	980	686	1,000	700
and	Westbound Ramp	485	268	538	284	510	282
	AF Entrance	485	268	538	284	510	282
	Eastbound Ramp 1	360	285	380	302	380	314
	Eastbound Ramp 2	360	285	380	302	380	314
Randall Avenue	Eastbound Ramp	300	210	380	266	320	224
	Westbound	450	319	570	399	480	336

Table 3.1-1 Continued, Page 6 of 6
PREDICTED TRAFFIC VOLUMES AT SELECTED ROADWAYS AND INTERSECTIONS FOR 1985 AND 1990

		Number of Vehicles per Hour					
		1985 (No Action Alternative)		1985 (Proposed Action)		1990 (No Action Alternative/ Proposed Action)	
Roadway Configuration	Link	1-hr Analysis	8-hr Analysis	1-hr Analysis	8-hr Analysis	1-hr Analysis	8-hr Analysis
Kimball, Nebraska[1]							
Route 71 and	Northbound	741	556	860	577	771	578
	Southbound	492	369	601	383	502	384
U.S. 30	Eastbound	887	665	951	691	922	692
	Westbound	632	474	687	492	657	493
Wheatland, Wyoming[1]							
16th Street and	Northbound	960	698	1,140	829	1,040	756
	Southbound	960	698	1,140	829	1,040	756
South Street	Eastbound	1,304	948	1,484	1,079	1,412	1,027
	Westbound	1,304	948	1,484	1,079	1,412	1,027

Note: [1] Peak year 1986 shown in 1985 column.

3.1.2.2.1 24-Hour Modeling

The EPA computerized CRSTER model (EPA 1977) was used as a screening procedure to identify the worst-case meteorological dispersion days from the 5 years (1960 to 1964) of meteorological data. The meteorological preprocessor program within the CRSTER model converted hourly surface observations along with upper air data into a usable form for the CRSTER model dispersion algorithms. With some modifications, the point source CRSTER model was used to simulate an area source model. By inputting generic emissions data and geometries, the CRSTER model identified the 10 worst 24-hour periods. Worst days are a function of stability, wind speed, wind direction, and mixing height.

The meteorological parameters associated with the worst day was then incorporated into the EPA computerized Industrial Source Complex - Short Term model (EPA 1979b). Fugitive dust emission factors for specific sources were also incorporated into the model as well as a grid-type network of potential receptors. The results of the modeling yielded estimates of 24-hour fugitive dust concentrations.

The Industrial Source Complex - Short Term model calculates the total contribution of all sources for each hour and averages these values over a 24-hour period. The area emission sources are set up as a series of equal-emission grids on a x-y coordinate system. The grid, or series of grids, simulate the area source at ground level. Receptors can be placed discretely or be internally generated and can be placed on either a Cartesian or Polar coordinate system. Receptors can be placed in between area sources to simulate widespread multiple activities.

A sensitivity test was run with the Industrial Source Complex - Short Term model to determine the ground level receptor with the highest concentration for each site. These receptors were used to determine maximum downwind concentrations.

3.1.2.2.2 Annual Modeling

Annual fugitive dust emissions were calculated using the computerized EPA Climatological Dispersion Model (EPA 1973). Since the primary long-term emission sources were with the Cheyenne area, i.e., F.E. Warren AFB and residential construction, the State of Wyoming's modified version of the model was used (hereafter referred to as Climatological Dispersion Model - Wyoming) (WDEQ 1983c). The Climatological Dispersion Model - Wyoming is an area and point source model for the analysis of the physical transport of gaseous and particulate pollutants. Each source was located on a Cartesian grid system and surrounded by a similar grid of potential receptors.

The model incorporates statistical meteorological parameters, source fugitive dust emission factors, and specific assumptions governing particle size and mobility. Modeling results indicate annual fugitive dust emission concentrations at varying receptor distances from the source.

The Climatological Dispersion Model - Wyoming emission grid and receptor selection are similar to those used with the Industrial Source Complex - Short Term model except that the Wyoming model accepts only discrete information and only on a Cartesian coordinate system. Emissions input for the Climatological Dispersion Model - Wyoming is somewhat different than that for the Industrial Source Complex - Short Term model due to the statistical method in which it calculates annual total suspended particulate concentrations.

3.1.3 Visibility

3.1.3.1 Baseline Future - No Action Alternative

Projected future levels of regional visibility were based on visual range distances determined from review of existing documentation and coordination with the WDEQ (1983a) and the NDEC (1983a).

3.1.3.2 Proposed Action

The primary concern of visibility impairment resulting from project implementation was from fugitive dust associated with various construction activities at F.E. Warren AFB, and in Cheyenne and the DA. The EPA Visibility Workbook (EPA 1980b) was used to determine potential regional visibility impairment resulting from these sources.

All project-related pollutant sources were combined and treated as one worst-case area source. The model was run to determine potential visibility impairment at the nearest Class I/Category I area. Various visual range and contrast parameters were calculated based on emissions, geographic location, and source-receptor distance. The calculations are presented in detail in Appendix C. Results were in the form of a pass/fail criteria. If the initial screening procedure indicates calculated values below the criteria values, no further analysis would be required. If the calculated values are above the criteria levels, progressively more refined procedures would be undertaken.

3.2 Assumptions and Assumed Mitigations

3.2.1 Assumptions

The assumptions discussed below are general and relate to the specific assessment activity performed for each air quality element. A presentation of the assumptions implicit in each of the simulation models or procedures presented in Section 3.1 is contained in Appendix B.

3.2.1.1 Carbon Monoxide

Vehicular speeds at signed and signalized intersections were assumed to average 10 miles per hour (mph) and 15 mph for the 1-hour and 8-hour periods, respectively. This assumption was justified based upon comparison of existing and projected traffic volumes to roadway capacity, and the observed absence of significant vehicular queuing at the intersections evaluated.

Vehicular speeds along roadway segments were assumed to be at the posted speed limit for both the 1-hour and 8-hour time periods. Predicted vehicular speeds, along with MOBILE 2 emission factors, are presented in Table 3.2-1.

Table 3.2-1

PREDICTED VEHICULAR SPEEDS AND EMISSION
FACTORS AT SELECTED ROADWAYS AND INTERSECTIONS
FOR 1985 AND 1990

Roadway Configuration	Parameter	1985 (No Action Alternative) 1-hr Analysis	1985 (No Action Alternative) 8-hr Analysis	1985 (Proposed Action) 1-hr Analysis	1985 (Proposed Action) 8-hr Analysis	1990 (No Action Alternative/ Proposed Action) 1-hr Analysis	1990 (No Action Alternative/ Proposed Action) 8-hr Analysis
Roadway Segments							
Cheyenne, Wyoming							
Interstate 25	Speed (mph)	55	55	55	55	55	55
	CO Emissions (grams/mile)	34	30	34	30	27	22
Interstate 80	Speed	55	55	55	55	55	55
	CO Emissions	35	33	35	33	27	23
College Drive	Speed	40	40	40	40	40	40
	CO Emissions	55	38	55	38	40	29
Missile Drive (Interstate 25 to 20th Street)	Speed	30	30	30	30	30	30
	CO Emissions	72	51	72	51	54	40
Ames Avenue (Parsley Boulevard to 20th Street)	Speed	30	30	30	30	30	30
	CO Emissions	72	51	72	51	54	40
Lincolnway (Pershing Boulevard to Ridge Road)	Speed	45	45	45	45	45	45
	CO Emissions	53	37	53	37	39	28
Windmill Road (Dell Range Boulevard to Pershing Boulevard)	Speed	40	40	40	40	40	40
	CO Emissions	55	39	55	39	40	30

Table 3.2-1 Continued, Page 2 of 2
PREDICTED VEHICULAR SPEEDS AND EMISSION FACTORS AT SELECTED ROADWAYS AND INTERSECTIONS FOR 1985 AND 1990

		1985 (No Action Alternative)		1985 (Proposed Action)		1990 (No Action Alternative/ Proposed Action	
Roadway Configuration	Parameter	1-hr Analysis	8-hr Analysis	1-hr Analysis	8-hr Analysis	1-hr Analysis	8-hr Analysis
Ridge Road (Four Mile Road to Dell Range Boulevard)	Speed CO Emissions	30 72	30 51	30 72	30 51	30 54	30 40
Prairie Avenue (Yellowstone Road to Dell Range Boulevard)	Speed CO Emissions	30 72	30 51	30 72	30 51	30 54	30 40
Central Avenue (Interstate 25 to Yellowstone Road)	Speed CO Emissions	30 72	30 51	30 72	30 51	30 54	30 40
Intersections							
Cheyenne, Wyoming							
All Cheyenne Intersections	Speed CO Emissions	10 163	15 86	10 163	15 86	10 126	15 70
Kimball, Nebraska[1]							
Route 71 and U.S. 30	Speed CO Emissions	10 151	15 81	10 151	15 81	10 126	15 70
Wheatland, Wyoming							
16th Street and South Street	Speed CO Emissions	10 151	15 81	10 151	15 81	10 126	15 70

Note: [1] Peak year is 1986, shown in 1985 columns.

Hot and cold vehicular operation modes were assumed at 10 percent and 5 percent, respectively, for 1-hour and 8-hour periods for expressways (i.e., Interstates 25 and 80) and 30 percent and 20 percent, respectively, for the 1-hour and 8-hour periods for local roadways. These percentages reflect standard conditions and indicate the increased number of vehicles in hot and cold-start mode on local roadways.

The atmospheric mixing height was assumed to be 1,000 meters for CALINE 3 modeling. This height is a standard default value used in the model.

3.2.1.2 Fugitive Dust

It was assumed that the climatological data (surface meteorological data collected at Cheyenne Airport and upper air meteorological data collected at Denver's Stapleton Airport) used in the Climatological Dispersion Model - Wyoming, CRSTER, and Industrial Source Complex - Short Term models were representative of the entire project area.

Standard construction practices were assumed with respect to all construction activities including the derivation of work day length, daily quantity of aggregate deposited and leveled, typical daily average land disturbance, etc. The Dodge Guide to Public Work and Heavy Construction Costs (Dodge Guide 1981) was useful in determining such items as the amount of fill that can be placed and graded by a typical crew on a typical day.

It was assumed that the rural background fugitive dust emissions were constant throughout the project area. The background value, 17.5 microgram per cubic meter (ug/m^3), was chosen from a review of existing monitored data in Wyoming and was confirmed with the WDEQ (1983a) and NDEC (1983a).

It was also assumed that the major sources of construction-related fugitive dust emissions in the DA were activities at the LF sites, cable trenching, and roadway resurfacing. The primary source of emissions on F.E. Warren AFB was assumed to be construction of new buildings and roadways.

3.2.1.3 Visibility

The EPA Visibility Workbook screening procedure assumes that steady-state meteorological conditions (i.e., wind direction) exist that would cause the pollutants to be transported continuously to the receptor within a 24-hour period.

3.2.2 Assumed Mitigations

The fugitive dust analysis assumes standard engineering and construction mitigations. The mitigation measure assumed was the use of chemical treatment (palliatives) of exposed land area, unpaved roadways, storage piles and other high-suspension dust sources, which are at least 50 percent effective in curtailing total suspended particulate emissions. Emission levels from all construction vehicles were assumed to comply with all federal, state, and local air quality regulations.

3.3 Level of Impact Definitions

This section presents a review of the federal, state, and local air quality standards and regulations that served as a basis for defining impacts of the project. The rationale for applying these standards and regulations to develop level of impact criteria for the project is discussed.

Since air quality standards are represented by various units of measurement, the following general description of these units applies:

- o Micrograms per cubic meter (ug/m^3);
- o Milligrams per cubic meter (mg/m^3); and
- o Parts per million (ppm).

A microgram is one millionth of a gram, while a milligram is one thousandth of a gram. Both micrograms and milligrams are measures of mass; parts per million is a volumetric measurement. All three units are expressed with respect to the National, Nebraska, and Wyoming Ambient Air Quality Standards. Prevention of Significant Deterioration and EPA minimum level increments are expressed in micrograms per cubic meter.

Air quality impacts of the project are judged primarily on the degree of compliance with federal and state ambient air quality standards and EPA Prevention of Significant Deterioration criteria. National Ambient Air Quality Standards have been promulgated by the EPA for six criteria pollutants: sulfur dioxide, nitrogen dioxide, CO, hydrocarbons, total suspended particulates, lead, and ozone. Individual states may promulgate their own air quality standards with the proviso that the standards must be at least as stringent as national standards. The State of Nebraska has adopted the national standards without amendment. Wyoming has amended the national standards to make their own standards more stringent for ozone, sulfur dioxide, and total suspended particulates. The National Ambient Air Quality Standards and Ambient Air Quality Standards for the states of Nebraska and Wyoming are shown in Table 3.3-1.

An area in which existing air quality is better than the applicable ambient air quality standard is referred to as being in "attainment" for the pollutant. If ambient air quality standards are exceeded, the area is defined as in nonattainment for each pollutant in violation of a standard. Each state has been required by the EPA to prepare a State Implementation Plan that contains proposed measures to maintain attainment areas and to bring nonattainment areas into compliance with the National Ambient Air Quality Standards (Federal Register 1980). The State of Nebraska received approval for its Implementation Plan in 1982, with the cities of Omaha and Lincoln classified nonattainment for CO and the counties of Omaha and Cass classified nonattainment for total suspended particulates (Bureau of National Affairs, Inc. 1983). The State of Wyoming prepared and received approval for its Implementation Plan. However, final approval of several revisions and corrections to the Wyoming Plan are pending (Federal Register 1982).

Table 3.3-1

SUMMARY OF NATIONAL, NEBRASKA, AND WYOMING AMBIENT AIR QUALITY STANDARDS[1]

Pollutant	Averaging Time	National and Nebraska Standards Primary	National and Nebraska Standards Secondary	Wyoming Standards
Carbon Monoxide	8 hour	10 mg/m^3 (9 ppm)	a	10 mg/m^3 (9 ppm)
	1 hour	40 mg/m^3 (35 ppm)	a	40 mg/m^3 (35 ppm)
Carbon Monoxide (above 5,000 feet)	8 hour	10 mg/m^3 (9 ppm)	a	10 mg/m^3 (9 ppm)
	1 hour	40 mg/m^3 (35 ppm)	a	40 mg/m^3 (35 ppm)
Hydrocarbons[2] (non-methane)	3 hour (6-9 AM)	160 $\mu g/m^3$ (0.24 ppm)	a	160 $\mu g/m^3$ (0.24 ppm)
Lead	3 month average	1.5 $\mu g/m^3$	a	N/A
Nitrogen Dioxide	Annual	100 $\mu g/m^3$ (0.05 ppm)	a	100 $\mu g/m^3$ (0.05 ppm)
Ozone	1 hour	240 $\mu g/m^3$ (0.12 ppm)	a	160 $\mu g/m^3$ (0.08 ppm)
Sulfur Dioxide	Annual	80 $\mu g/m^3$ (0.03 ppm)	None	60 $\mu g/m^3$ (0.02 ppm)
	24 hour	365 $\mu g/m^3$ (0.14 ppm)	None	260 $\mu g/m^3$ (0.10 ppm)
	3 hour	None	1,300 $\mu g/m^3$ (0.5 ppm)	1,300 $\mu g/m^3$ (0.5 ppm)
Total Suspended Particulates	Annual (geometric mean)	75 $\mu g/m^3$	60 $\mu g/m^3$	60 $\mu g/m^3$
	24 hour	260 $\mu g/m^3$	150 $\mu g/m^3$	150 $\mu g/m^3$

Table 3.3-1 Continued, Page 2 of 2
SUMMARY OF NATIONAL, NEBRASKA, AND WYOMING AMBIENT AIR QUALITY STANDARDS[1]

Notes: [1] Standards, other than those based on annual averages or annual geometric means, are not to be exceeded more than once per year.

[2] For use as a guide in devising implementation plans to achieve the ozone standard.

[a] Same as primary standard

ppm - parts per million
mg/m^3 - milligrams per cubic meter ($10^{-3} g/m^3$)
$\mu g/m^3$ - micrograms per cubic meter ($10^{-6} g/m^3$)

N/A Not Applicable.

Source: Clean Air Act, 40 CFR, Part 40 1980, Wyoming Department of Environmental Quality, Air Quality Standards and Regulations 1982b, Nebraska Department of Environmental Control, Air Pollution Control Rules and Regulations 1982a.

An additional level of air quality control criteria has been established with the Prevention of Significant Deterioration regulations. The purpose of the EPA Prevention of Significant Deterioration program is to preserve air quality in areas where ambient standards are presently being met. For the purposes of Prevention of Significant Deterioration, attainment areas are divided into three classifications: Class I (practically no deterioration is allowed); Class II (moderate, well-controlled industrial growth is allowed); and Class III (a considerable amount of industrial growth is allowed). In addition, a state may classify its own Category I areas which fall under the same criteria. Pollutant concentrations or increments, due to a source regulated by Prevention of Significant Deterioration, that cannot be exceeded in an attainment area, were established in the Clean Air Act Amendments of 1977 for sulfur dioxide and total suspended particulates (Federal Register 1980). These increments are listed in Table 3.3-2.

Table 3.3-2

EPA MAXIMUM ALLOWABLE INCREMENTS FOR PREVENTION OF SIGNIFICANT DETERIORATION[1]

Pollutant	Averaging Time	Class I	Class II	Class III
Sulfur Dioxide	Annual	2	20	40
	24-hr maximum[2]	5	91	182
	3-hr maximum[2]	25	512	700
Total Suspended Particulates	Annual	5	19	37
	24-hr maximum[2]	10	37	75

Notes: [1] Increments given in micrograms per cubic meter

[2] Not to be exceeded more than once a year

Source: Federal Register, Volume 43, Number 118, June 19, 1978.

Mandatory Class I status is assigned by Congress to all international parks, national wilderness areas, memorial parks larger than 5,000 acres, and national parks larger than 6,000 acres. Class III status may be assigned by states to areas that wish to allow maximum industrial growth while still maintaining compliance with National Ambient Air Quality Standards. All remaining attainment areas are designated Class II (Federal Register 1980).

The EPA defines minimum threshold increments for air pollutants. Although these minimum threshold increments were developed to apply to emissions from new or modified major sources in nonattainment areas (i.e., those generally emitting greater than 100 to 250 tons per year of any air pollutant as a function of industrial source type), they are used in the present study to better refine the level of impact definitions. The minimum threshold increments are shown in Table 3.3-3.

Table 3.3-3

EPA MINIMUM THRESHOLD INCREMENTS FOR AIR POLLUTANTS[1]

Pollutant	Annual	24 hour[2]	8 hour[2]	3 hour[2]	1 hour[2]
Sulfur Dioxide	1	5	N/A	25	N/A
Total Suspended Particulates	1	5	N/A	N/A	N/A
Nitrogen Dioxide	1	N/A	N/A	N/A	N/A
Carbon Monoxide	N/A	N/A	500	N/A	2,000

Notes: [1] Increments given in micrograms per cubic meter
[2] Not to be exceeded more than once a year
N/A Not applicable

Source: Federal Register, Volume 43, Number 118, June 19, 1978.

With enactment of the Clean Air Act, Congress established as a national goal the prevention of any future, and remedy of any existing, impairment of visibility in mandatory Class I areas in which visibility is an important value. California and Nevada have in addition established quantitative standards for visibility impairment for the Lake Tahoe area (California State Air Resources Board 1982, Nevada Division of Environmental Protection 1982).

The effects on air quality and visibility may be classified as having negligible, low, moderate, or high impact depending upon the general health effects of the pollutants generated by project facilities and/or activities as measured by ground level concentrations and their relationship to applicable ambient air quality standards or criteria. Analysis in this report includes a breakdown of levels of impact both by geographic scale and duration, as appropriate.

3.3.1 Carbon Monoxide

The effects of CO are confined to the local scale due to CO's rapid dispersion characteristics. The levels of impact for this pollutant are defined as follows:

- o Negligible Impact - Predicted incremental CO concentrations will not equal or exceed EPA minimum threshold levels (500 ug/m^3 or 0.45 ppm over an 8-hour period, or 2,000 ug/m^3 or 1.8 ppm over a 1-hour period). No general health effects will occur.

- o Low Impact - Predicted incremental CO concentrations will equal or exceed EPA minimum threshold levels, but the concentrations plus background will not exceed 50 percent of the National Ambient Air Quality Standards (5,000 ug/m^3 or 4.5 ppm over an 8-hour period, or 20,000 ug/m^3 or 17.5 ppm over a 1-hour period). The Wyoming and Nebraska Ambient Air Quality Standards for CO are the same as the National Ambient Air Quality Standards. No general health effects will occur but pollutant concentration increases will be detectable.

- o Moderate Impact - Predicted incremental CO concentrations plus background will exceed 50 percent of the National Ambient Air Quality Standards, but the concentrations plus background will not exceed the National Ambient Air Quality Standards (10,000 ug/m^3 or 9 ppm over an 8-hour period, or 40,000 ug/m^3 or 35 ppm over a 1-hour period). No general health effects will occur but pollutant concentrations rise measurably.

- o High Impact - Predicted incremental CO concentrations will exceed National Ambient Air Quality Standards (10,000 ug/m^3 or 9 ppm over an 8-hour period, or 40,000 ug/m^3 or 35 ppm over a 1-hour period) when combined with background concentrations. General health effects will include mild aggravation of symptoms in susceptible people and initial symptoms will occur in the healthy population.

3.3.2 Fugitive Dust

The effects of fugitive dust on the local and regional scale are classified as follows:

- o Negligible Impact - Predicted incremental concentrations of fugitive dust will not equal or exceed EPA minimum total suspended particulate threshold levels (1.0 ug/m^3 averaged annually or 5.0 ug/m^3 over a 24-hour period). No general health effects will occur.

- o Low Impact - Predicted incremental concentrations of fugitive dust will exceed minumum EPA total suspended particulate threshold levels, but the increment plus background concentrations of total suspended particulates will not exceed Wyoming total suspended particulate Ambient Air Quality Standards of 60 ug/m^3 averaged annually or 150 ug/m^3 over a 24-hour period. No general health effects will occur, but pollutant concentrations will rise measurably.

- o Moderate Impact - Predicted incremental concentrations of fugitive dust will exceed minimum EPA total suspended particulate threshold levels and the increment plus background concentrations of total suspended particulate will exceed Wyoming total suspended particulate Ambient Air Quality Standards of 60 ug/m^3 averaged annually or 150 ug/m^3 over a 24-hour period but will not exceed the total suspended particulate National Ambient Air Quality Standards of 75 ug/m^3 averaged annually or 260 ug/m^3 over a 24-hour period. The Nebraska Ambient Air Quality Standards for total suspended particulates are the same as the National Ambient Air Quality Standards. The onset of minor general health effects may appear among susceptible people.

- o High Impact - Predicted incremental concentrations of fugitive dust will exceed the total suspended particulate National Ambient Air Quality Standards (75 ug/m^3 averaged annually or 260 ug/m^3 over a 24-hour period) when combined with background concentrations of total suspended particulates. General health effects will begin with mild aggravation of symptoms in susceptible people and symptoms of irritation in the healthy population. As concentrations become higher, general health effects will include major aggravation of symptoms and decreased exercise tolerance in people with heart or lung disease.

3.3.3 Visibility

The air quality effects on visibility are determined for Class I and Category I areas (regional scale). The level of impairment of visibility as applicable to the project area will be classified as follows:

- o Negligible Impact - Predicted levels of visual range will not be less than the existing project area median yearly visual range of 64 miles.

- o Low Impact - Predicted levels of median yearly visual range will be between 50.0 to 63.0 miles.

- o Moderate Impact - Predicted levels of median yearly visual range will be between 30.0 to 49.0 miles.

- o High Impact - Predicted levels of median yearly visual range will be less than 30.0 miles.

3.4 Significance Determination

For the air quality analysis, an increase in predicted concentration of an individual pollutant when combined with background concentration levels, will be significant if it will equal or exceed the applicable ambient air quality standard, thus creating a law violation and potential health hazard. Predicted concentrations plus background measuring less than the applicable ambient air quality standard will be considered not significant. The impact on regional visibility will be considered significant if the predicted median yearly visual range is below 30 miles (creates a potential significant nuisance effect).

3.4.1 Carbon Monoxide

CO concentrations (i.e., predicted concentrations plus background levels) are defined as significant if they equal or exceed 10,000 ug/m^3 or 9 ppm over an 8-hour period, or 40,000 ug/m^3 or 35 ppm over a 1-hour period.

3.4.2 Fugitive Dust

Fugitive dust concentrations (i.e., predicted concentrations plus background levels of total suspended particulates) are defined as significant if they equal or exceed 75 ug/m^3 annually or 260 ug/m^3 over a 24-hour period.

3.4.3 Visibility

Visibility impairment is defined as significant when the predicted median yearly visual range is below 30 miles. Since no Wyoming standards exist for regional visibility impairment, the standards adopted by the states of California and Nevada were used for significance determination. These are the only states that have visibility standards.

3.5 Environmental Consequences of the Proposed Action and No Action Alternative

The following discussion presents the analytic results for the air quality impact analyses of the Proposed Action, project element alternatives and the No Action Alternative for the short term, 1985 (peak year of construction), and long term, 1990 (beginning year of operations). The No Action Alternative assumes no project and is based on anticipated, normal growth within the project area.

3.5.1 Carbon Monoxide

The assessment of CO concentrations from vehicular operation was performed for those roadway segments and roadway intersections presently or projected to convey increased traffic volumes. These generally included roadway segments in Cheyenne projected to have 10 percent or greater project-related increases in traffic volumes.

In assessing CO in the non-Cheyenne area, roadway intersections in Kimball, Scottsbluff, and Gering, Nebraska; and Torrington and Wheatland, Wyoming were reviewed as to project-related increases in vehicular traffic. Kimball, Nebraska and Wheatland, Wyoming were selected for analysis as representing the highest projected traffic volume increase of the project area outside Cheyenne. It should be noted, however, that these increases and, hence, the analysis were for 1986. All other peak year assessments were performed for 1985.

3.5.1.1 Baseline Future - No Action Alternative

The results of the CO assessment of the No Action Alternative for 1985 and 1990 are shown in Table 3.5-1. The CO concentrations represented in the table include 1-hour and 8-hour background concentrations of 1.0 ppm and 0.5 ppm, respectively. As can be noted from this table, no state or federal ambient air quality standards are equalled or exceeded.

Table 3.5-1

PREDICTED CARBON MONOXIDE CONCENTRATIONS AT SELECTED RECEPTORS FOR 1985 AND 1990[a]

Roadway Configurations	Averaging Time	No Action 1985 (ppm)	Proposed Action 1985 (ppm)	Difference Between Proposed Action and No Action 1985 (ppm)	No Action 1990 (ppm)	Proposed Action 1990 (ppm)	Difference Between Proposed Action and No Action 1990 (ppm)
Roadway Segments							
Cheyenne, Wyoming							
Interstate 25 (Central Avenue to Pershing Boulevard)	1 hour 8 hour	2.3 0.8	2.7 0.9	0.4 0.1	2.6 0.9	2.6 0.9	0 0
Interstate 25 (Pershing Boulevard to Missile Drive)	1 hour 8 hour	2.3 0.8	2.6 0.8	0.3 0.0	2.4 0.8	2.4 0.8	0 0
Interstate 25 (Missile Drive to Interstate 80)	1 hour 8 hour	2.1 0.7	2.2 0.7	0.1 0.0	2.3 0.7	2.3 0.7	0 0
Interstate 25 (Interstate 80 to College Drive)	1 hour 8 hour	2.1 0.7	2.2 0.7	0.1 0.0	2.3 0.7	2.3 0.7	0 0
Interstate 80 (Interstate 25 to Interstate 180)	1 hour 8 hour	1.6 0.7	1.6 0.7	0.0 0.0	1.6 0.6	1.6 0.6	0 0
Interstate 80 (Interstate 180 to College Drive)	1 hour 8 hour	1.5 0.6	1.5 0.7	0.0 0.1	1.5 0.6	1.5 0.6	0 0
College Drive (Interstate 25 to Parsley Boulevard)	1 hour 8 hour	2.4 0.8	2.5 0.8	0.1 0.0	2.4 0.8	2.4 0.8	0 0

Table 3.5-1 Continued, Page 2 of 4
PREDICTED CARBON MONOXIDE CONCENTRATIONS AT SELECTED RECEPTORS FOR 1985 AND 1990[a]

Roadway Configurations	Averaging Time	No Action 1985 (ppm)	Proposed Action 1985 (ppm)	Difference Between Proposed Action and No Action 1985 (ppm)	No Action 1990 (ppm)	Proposed Action 1990 (ppm)	Difference Between Proposed Action and No Action 1990 (ppm)
College Drive (Parsley Boulevard to Walterscheid Boulevard)	1 hour	3.1	3.3	0.2	3.2	3.2	0
	8 hour	0.9	1.0	0.1	1.0	1.0	0
College Drive (Walterscheid Boulevard to U.S. 85)	1 hour	3.2	3.2	0	3.2	3.2	0
	8 hour	1.0	1.0	0	1.0	1.0	0
Missile Drive (Interstate 25 to 20th Street)	1 hour	4.6	6.1	1.5	4.4	4.4	0
	8 hour	1.3	1.7	0.4	1.3	1.3	0
Ames Avenue (Parsley Boulevard to 20th Street)	1 hour	7.3	8.2	0.9	5.9	5.9	0
	8 hour	1.8	2.0	0.2	1.6	1.6	0
Lincolnway (Pershing Boulevard to Ridge Road)	1 hour	3.8	4.2	0.4	4.0	4.0	0
	8 hour	1.1	1.2	0.1	1.2	1.2	0
Windmill Road (Dell Range Boulevard to Pershing Boulevard)	1 hour	4.1	4.8	0.7	3.4	3.4	0
	8 hour	1.2	1.3	0.1	1.0	1.0	0
Ridge Road (Four Mile Road to Dell Range Boulevard)	1 hour	4.3	4.4	0.8	3.9	3.9	0
	8 hour	1.2	1.4	0.2	1.1	1.1	0
Prairie Avenue (Yellowstone Road to Dell Range Boulevard)	1 hour	7.3	8.4	1.1	7.0	7.0	0
	8 hour	1.9	2.2	0.3	1.9	1.9	0

Table 3.5-1 Continued, Page 3 of 4
PREDICTED CARBON MONOXIDE CONCENTRATIONS AT SELECTED RECEPTORS FOR 1985 AND 1990[a]

Roadway Configurations	Averaging Time	No Action 1985 (ppm)	Proposed Action 1985 (ppm)	Difference Between Proposed Action and No Action 1985 (ppm)	No Action 1990 (ppm)	Proposed Action 1990 (ppm)	Difference Between Proposed Action and No Action 1990 (ppm)
Central Avenue (Interstate 25 to Yellowstone Road)	1 hour	8.0	9.6	1.6	7.5	7.5	0
	8 hour	2.1	2.5	0.4	2.1	2.1	0
Intersections							
Cheyenne, Wyoming							
16th Street/Warren Avenue	1 hour	25.6	28.4	2.8	22.5	22.5	0
	8 hour	4.7	5.0	0.3	4.3	4.3	0
Pershing Boulevard/ Central Avenue	1 hour	18.1	23.5	5.4	17.4	17.4	0
	8 hour	3.2	4.0	0.8	3.3	3.3	0
Pershing Boulevard/ Warren Avenue	1 hour	21.9	23.1	1.2	22.1	22.1	0
	8 hour	4.0	4.1	0.1	4.1	4.1	0
Yellowstone Road/ Prairie Avenue	1 hour	27.5	30.7	3.2	24.0	24.0	0
	8 hour	5.4	5.9	0.5	4.9	4.9	0
Pershing Boulevard/ Randall Avenue	1 hour	9.0	10.5	1.5	7.6	7.6	0
	8 hour	1.8	2.1	0.3	1.7	1.7	0
Pershing Boulevard/ Converse Avenue	1 hour	18.9	20.8	1.9	16.4	16.4	0
	8 hour	3.9	4.2	0.3	2.6	2.6	0

Table 3.5-1 Continued, Page 4 of 4
PREDICTED CARBON MONOXIDE CONCENTRATIONS AT SELECTED RECEPTORS
FOR 1985 AND 1990[a]

Roadway Configurations	Averaging Time	No Action 1985 (ppm)	Proposed Action 1985 (ppm)	Difference Between Proposed Action and No Action 1985 (ppm)	No Action 1990 (ppm)	Proposed Action 1990 (ppm)	Difference Between Proposed Action and No Action 1990 (ppm)
20th Street/Warren	1 hour	17.2	19.0	1.8	13.9	13.9	0
Avenue	8 hour	3.4	3.6	0.2	2.8	2.8	0
Dell Range Boulevard/	1 hour	10.6	11.3	0.7	11.2	11.2	0
Ridge Road	8 hour	2.3	2.4	0.1	2.6	2.6	0
Kimball, Nebraska[b]							
Route 71/U.S. 30	1 hour	6.1	8.1	2.0	5.7	5.7	0
	8 hour	1.2	1.5	0.3	1.2	1.2	0
Wheatland, Wyoming[b]							
16th Street/	1 hour	18.0	20.7	2.7	16.3	16.3	0
South Street	8 hour	3.3	3.8	0.5	3.1	3.1	0

Notes: a Includes 1.0 ppm and 0.5 ppm background carbon monoxide levels for 1 and 8-hour periods, respectively.

b Peak year occurs in 1986.

The highest concentrations are predicted at intersections since CO emissions increase as vehicular speeds decrease. The intersection of Yellowstone Road and Prairie Avenue in Cheyenne is predicted to have the highest CO concentrations in both 1985 and 1990. The predicted 1-hour concentrations in 1985 and 1990 are 27.5 and 24.0 ppm, respectively, while the 8-hour concentrations are 5.4 ppm and 4.9 ppm, respectively. The highest predicted 1-hour concentrations along a roadway segment, Central Avenue (in Cheyenne) between Interstate 25 and Yellowstone Road, are 8.0 ppm and 7.5 ppm in 1985 and 1990, respectively. Eight-hour concentrations along these same sections are 2.1 ppm for both 1985 and 1990. All 1-hour and 8-hour predicted CO concentrations are below applicable ambient air quality standards.

3.5.1.2 Proposed Action

The results of the CO assessment for 1985 (short term) and 1990 (long term) are shown in Table 3.5-1. The values, likewise, include the 1-hour and 8-hour background CO concentrations.

For the short term (1985), the Proposed Action was predicted to result in low, not significant impacts of CO in Cheyenne, Kimball, and Wheatland. The largest increase in CO was predicted in Cheyenne at the intersection of Pershing Boulevard and Central Avenue which was 5.4 ppm and 0.8 ppm for the 1-hour and 8-hour periods, respectively, as compared to the No Action Alternative. For roadway segments, the largest increase in CO was predicted along Central Avenue in Cheyenne between Interstate 25 and Yellowstone Road. This increase was 1.6 ppm and 0.4 ppm for the 1-hour and 8-hour periods, respectively, as compared to the No Action Alternative. Missile Drive between Interstate 25 and 20th Street was also predicted to have an increase of 0.4 ppm for the 8-hour period, as compared to the No Action Alternative. No project-related increases in CO concentrations were predicted for the long term (1990). In fact, decreases in CO concentrations between 1985 and 1990 were generally predicted due to anticipated greater usage of vehicular pollution control devices. All 1-hour and 8-hour predicted CO concentrations were below applicable federal and state ambient air quality standards.

Since CO is primarily associated with congested transportation sources, it is a unique problem for urban areas. No CO impact assessment was performed for construction activities at affected silos, access roads, DA roads, and cable paths since these areas are primarily rural in nature.

Because of the minimal increases in traffic volumes associated with project alternatives, the impact of CO with respect to construction of any of the alternative road access routes at F.E. Warren AFB, dispatch station alternatives, or cable route alternatives is predicted to be negligible and not significant.

3.5.2 Fugitive Dust

3.5.2.1 Baseline Future - No Action Alternative

Increases in fugitive dust emissions are expected in the project area due to population growth and nonproject-related construction. The assessment of these increases is not possible since the exact time, location, type, and level of construction and operational activities are necessary for quantification of impacts. The existing urban background concentration of 30 ug/m^3 and rural concentration of 17.5 ug/m^3 for fugitive dust (total suspended particulates) is conservatively assumed to remain constant for the future conditions. During the past several years, ambient levels of total suspended particulates have been decreasing even though population has been increasing. Rural concentrations of total suspended particulates are primarily due to natural sources and agricultural activities, which are expected to remain relatively constant.

3.5.2.2 Proposed Action

The 24-hour and annual analyses indicate that the predicted short-term impacts of fugitive dust concentrations, when added to the appropriate rural or urban background concentration values, are low and not significant. The predicted concentrations of fugitive dust exceed the EPA minimum total suspended particulate threshold levels (1.0 ug/m^3 averaged annually and 5.0 ug/m^3 over a 24-hour period). However, the predicted concentrations plus the background concentrations of total suspended particulates do not exceed the Wyoming total suspended particulate Ambient Air Quality Standards of 60 ug/m^3 averaged annually or 150 ug/m^3 over a 24-hour period. The impact is not significant because the predicted concentrations plus background are less than the applicable ambient air quality standards (75 ug/m^3 averaged annually or 260 ug/m^3 over a 24-hour period). Long-term impacts are negligible and not significant because construction activity, the primary source of project-related fugitive dust, will cease when the construction activities end.

The impact of fugitive dust with respect to construction of any of the alternative road access routes at F.E. Warren AFB, and cable path options is predicted to be low and not significant while the impact of the dispatch station options is predicted to be negligible and not significant.

3.5.2.2.1 24-Hour Impacts

Maximum 24-hour concentrations of fugitive dust from each proposed facility construction site at F.E. Warren AFB are predicted to be less than 1.0 ug/m^3. Roadway construction activities at the base are predicted to result in maximum concentrations of about 16 ug/m^3 at a distance of about 300 meters from the boundary of the base. The 24-hour predicted concentrations of fugitive dust generated by construction at F.E. Warren AFB are presented in Table 3.5-2. The maximum 24-hour concentration from projected residential development construction is predicted to be about 42.0 ug/m^3 occurring at a distance of about 250 meters.

Current projections indicate that approximately 642 miles of roadway may be upgraded to meet necessary specifications for access to the DA. Roadway construction activities are presently encompassed by resurfacing Option A, which consists of combining part asphalt and part gravel upgrade for existing Defense Access Roads (DARs), and resurfacing Option B, which consists of paving all gravel DARs. At sites where paving will occur, a mobile asphalt batching plant will be used. In addition, raising of bridge heights and/or lowering of pavement profiles may occur. Analysis of these roadway construction activities, including dumping and grading of materials, results in a predicted maximum 24-hour concentration of 112 ug/m^3 occurring at a distance

Table 3.5-2

INDUSTRIAL SOURCE COMPLEX - SHORT TERM DISPERSION MODEL RESULTS FOR FUGITIVE DUST EMISSION SOURCES ON F.E. WARREN AFB

Receptor	Distance From Closest Emission Source (meters)	Predicted Concentration from Emission Sources ($\mu g/m^3$)	Total Concentration Including Background[1] ($\mu g/m^3$)
West of F.E. Warren AFB 160 Meters from Property Line	500	1.39	31.39
Private Residential Housing Tracts West of Interstate 25, Corner of Buffalo Avenue and Western Hill Boulevard	1,700	0.68	30.68
North of F.E. Warren AFB 300 Meters from Corner of Buffalo Avenue and Western Hill Boulevard	1,800	15.93	45.93
Central High School, East of Interstate 25	2,400	0.14	30.14
Frontier Park, East of Interstate 25	1,100	0.01	30.01
Private Residential Housing Tract, East of Interstate 25, Corner of 8th Avenue and Hynds Boulevard	800	1.38	31.38
Private Residential Housing Tract, East of Interstate 25, Corner of Cosgriff Court and Hynds Boulevard	600	0.00	30.00

Note: [1] Includes background concentration of 30.00 $\mu g/m^3$.

of 185 meters. Analysis of the trenching operations associated with the laying of communications cable results in a predicted concentration of 15 ug/m^3 at 260 meters.

Proposed construction-related activities in and around the LF sites are associated with dumping and grading activities and improvement of the access roads. The analysis results in a predicted maximum concentration of about 55 ug/m^3. No cumulative impacts are predicted between LF sites.

Fugitive dust resulting from wind erosion at a dispatch station is predicted to result in a maximum concentration of 3 ug/m^3 at a distance of 200 meters.

3.5.2.2.2 Annual Impacts

Area source emissions were developed for construction activities at various locations within F.E. Warren AFB.

For the most conservative approach, a worst-case analysis of construction within F.E. Warren AFB assumes that all construction sites are potential fugitive dust sources. Maximum annual concentrations predicted at the base boundaries are less than 0.3 ug/m3, at distances of 600 meters. Results of this analysis using the Climatological Dispersion Model - Wyoming are presented in Table 3.5-3.

Annual impact analyses were not undertaken for roadway construction at F.E. Warren AFB, residential development construction, roadway construction and improvement in the DA, construction at the LFs, dispatch stations, or cable trenching operations because these activities will be of a limited and temporary nature at any given location and, thus, were analyzed only for the 24-hour averaging period.

3.5.3 Visibility

3.5.3.1 Baseline Future - No Action Alternative

For the No Action Alternative, it is assumed that the median yearly visual range of 64 miles for the project area will remain unchanged.

3.5.3.2 Proposed Action

The EPA Visibility Workbook was used to determine potential visibility impairment resulting from project-related increases in fugitive dust. All project-related sources, including F.E. Warren AFB, residential housing developments, the DA, dispatch stations, and LFs are combined and treated as one worst-case area source. The analysis indicates that no degradation of regional visibility at the nearest Prevention of Significant Deterioration Class I areas (Rocky Mountain National Park and Rawah Wilderness) is predicted. Thus the short and long-term impacts were predicted to be negligible and not significant.

The impact on regional visibility with respect to construction of any of the alternative road access routes at F.E. Warren AFB, dispatch station alternatives, or cable path alternatives is predicted to be negligible and not significant.

Table 3.5-3

CLIMATOLOGICAL DISPERSION MODEL - WYOMING RESULTS FOR FUGITIVE DUST EMISSION SOURCES ON F.E. WARREN AFB

Receptor	Distance From Closest Emission Source (meters)	Predicted Concentration from Emission Sources ($\mu g/m^3$)	Total Concentration Including Background[1] ($\mu g/m^3$)
West of F.E. Warren AFB 160 Meters from Property Line	500	0.10	30.10
Private Residential Housing Tracts West of Interstate 25, Corner of Buffalo Avenue and Western Hill Boulevard	1,700	0.11	30.11
North of F.E. Warren AFB 300 Meters from Corner of Buffalo Avenue and Western Hill Boulevard	1,800	0.10	30.10
Central High School East of Interstate 25	2,400	0.09	30.09
Frontier Park, East of Interstate 25	1,100	0.19	30.19
Private Residential Housing Tract, East of Interstate 25, Corner of 8th Avenue and Hynds Boulevard	800	0.19	30.19
Private Residential Housing Tract, East of Interstate 25, Corner of Cosgriff Court and Hynds Boulevard	600	0.24	30.24

Note: [1] Includes background concentration of 30.0 $\mu g/m^3$.

3.6 Summary of Impacts

3.6.1 Impact Matrix

The air quality impact matrix presents results of the various analyses performed in this study including a summary of the levels of impact and significance determination for each element (Figures 3.6-1 and 3.6-2).

Low, short-term, not significant local impacts of CO are predicted for several intersections and road segments in Cheyenne, Kimball, and Wheatland. Construction activities in Cheyenne and the DA are predicted to result in low, short-term, not significant local impacts and negligible, short-term, not significant regional impacts of fugitive dust. Negligible, short-term, not significant regional impacts on visibility are also predicted.

All long-term impacts for the three air quality elements are predicted to be negligible and not significant due to minimal increases in vehicular traffic and construction activity during project operations.

All the alternative road access routes at F.E. Warren AFB and cable path alternatives are predicted to result in low, not significant impacts of fugitive dust and negligible, not significant impacts of CO and visibility while the impact of all the dispatch station alternatives are predicted to be negligible and not significant.

3.6.2 Aggregation of Elements, Impacts, and Significance

The aggregated rating of air quality for the project results in low, short-term, not significant local impacts; negligible, short-term, not significant regional impacts; and negligible, long-term, not significant local and regional impacts (Figure 3.6-1). The alternatives aggregated to a low, not significant impact for the F.E. Warren access roads and the cable paths. The dispatch station alternatives impacts are negligible and not significant (Figure 3.6-2).

Determination of the overall impact rating for air quality involved aggregation of the impact ratings for the elements (components) of air quality. The air quality components were evaluated as described in Section 3.5 and then aggregated to the resource level by giving a higher weighting factor to the impacts and significance of those components which have the potential to cause health effects (which may be equivalent to causing exceedance of standards). Ambient air quality standards have been established by the EPA and in some cases (i.e., Wyoming), redefined more stringently by state regulatory agencies. These standards set concentration limits which are not be be exceeded by a new or modified emissions source when added to background concentrations. Both CO and fugitive dust were given an equal but higher weighting factor than visibility. Since air quality levels are determined by the cumulative impact of all atmospheric pollutants, the pollutant ("criteria pollutant") with the highest impact and significance influences the overall level of impact and significance for air quality.

LEGEND		ADVERSE IMPACTS	SIGNIFICANT ADVERSE IMPACTS
LEVEL OF IMPACT*	LOW	∘	•
	MODERATE	○	●
	HIGH	◯	⬤
POTENTIAL BENEFICIAL EFFECTS			(shaded box)
*MEASURE OF THE AMOUNT OF ENVIRONMENTAL CHANGE			

	PROJECT IMPACTS					
	SHORT TERM			LONG TERM		
	SITE	LOCAL	REGIONAL	SITE	LOCAL	REGIONAL
AIR QUALITY		o				
Carbon Monoxide		o				
Fugitive Dust		o				
Visibility						

AIR QUALITY
SUMMARY IMPACT MATRIX

FIGURE NO. 3.6-1

LEGEND

LEVEL OF IMPACT Measure of the Amount of Environmental Change	Adverse Impacts	Significant Adverse Impacts
Low	○	●
Moderate	○	●
High	○	●
Potential Beneficial Effects		

AIR QUALITY ALTERNATIVES COMPARISON MATRIX

	Cable Paths[1]											Roads[2]			Staging[3]		
	Proposed Action					Alternatives											
	PA1	SB1	RB1	PA4	PA5	PD1	SB2	PB1	PA2	PA3	RB2	R1	R2	R3	Proposed	Alt.	None
Air Quality	○	○	○	○	○	○	○	○	○	○	○	○	○	○			
Carbon Monoxide																	
Fugitive Dust	○	○	○	○	○	○	○	○	○	○	○	○	○	○			
Visibility																	

Notes: 1 Denotes specific cable paths. For location of cable paths see Section 1.1
2 For location of alternative routes see Section 1.1
3 For loc. .ion of dispatch stations see Section 1.1

AIR QUALITY ALTERNATIVES COMPARISON MATRIX

FIGURE NO. 3.6-2

3.7 Mitigation Measures

The mitigation measures identified below may be considered to further minimize levels of impact. None, some, or all of the mitigation measures may ultimately be selected. Each measure identifies the party responsible to implement, but not necessarily to pay for, the measure, as well as the timing of implementation, if appropriate, and the anticipated effectiveness of the measure.

- Use of covered trucks to haul aggregate to construction sites. This mitigation measure may be up to 90 percent effective in decreasing the quantity of atmospheric resuspension of particulate matter as trucks travel from borrow areas to deployment sites. If selected, this measure should be incorporated into design specifications prior to the onset of construction activities, i.e., spring 1984. The responsible agencies for implementation of this mitigation measure are the Air Force and state and local departments in conjunction with project contractors.

- Use of tarpaulin and/or revegetation of disturbed surfaces. The covering of aggregate storage piles with tarpaulins and the revegetation of disturbed surface areas, primarily a longer term measure, may be up to 90 percent effective in reducing the potential atmospheric resuspension of particulate matter. If selected, this mitigation measure should be incorporated into design specifications prior to the onset of construction activities, i.e., spring 1984. The responsible agencies for implementation of this mitigation measure are the Air Force and state and local departments in conjunction with project contractors.

- Speed restrictions for vehicles traveling on unpaved roads. Since at higher vehicular speeds greater quantities of particulate matter are resuspended from the unpaved roadway, this mitigation measure may be up to 80 percent effective in reducing fugitive dust emissions on DA roadways (EPA 1981b). If selected, this measure should be implemented at the onset of construction activities, i.e., spring 1985. The responsible agencies for implementation of this mitigation measure are the Air Force on F.E. Warren AFB and other governmental agencies outside F.E. Warren AFB.

3.8 Unavoidable Adverse Impacts

Short-term, short-duration unavoidable adverse air quality impacts due to fugitive dust emissions from construction activities would occur. Additionally, temporary increases in urban vehicular-related CO concentrations would occur. No unavoidable long-term air quality impacts are identified through the course of this assessment.

3.9 Irreversible and Irretrievable Resource Commitments

Implementation of the Proposed Action would result in no irretrievable nor irreversible resource commitments with respect to air quality.

3.10 The Relationship Between Local Short-Term Use of Man's Environment and Maintenance and Enhancement of Long-Term Productivity

Implementation of the Proposed Action would result in short-term air quality impacts primarily associated with the construction phase of the project. These impacts include increases in fugitive dust and vehicular CO exhaust emissions. No long-term air quality impacts have been identified and, hence, no effect on the maintenance and enhancement of long-term productivity is anticipated.

4.0

GLOSSARY

4.0 GLOSSARY

4.1 Terms

Ambient Air Quality Standards: standards established on a state or federal level which define the ceiling height for allowable ambient air quality concentrations for the designated criteria pollutants: nitrogen dioxide, sulfur dioxide, carbon monoxide, total suspended particulates, ozone, lead, and hydrocarbons.

Annual Average Daily Traffic: denotes daily traffic averaged over 1 calendar year.

Area of Concentrated Study: area(s) within the Region of Influence which will receive the majority of environmental impacts. Analysis of existing environmental conditions are described for, and impacts are focused within, the Area of Concentrated Study for this EPTR.

Area Source: pollution emissions from a spatial surface or area (e.g., dust from a tilled field).

At-Grade Road: a roadway surface at the same elevation as surrounding land, rather than on an elevated or depressed right-of-way.

Atmospheric Dispersion: the transport and mixing of gases or suspended particles in the atmosphere by winds and turbulent processes.

Attainment Area: an area that has been designated by the United States Environmental Protection Agency (EPA) and the appropriate state air quality agency as having ambient air quality levels below the ceiling levels defined under the National Ambient Air Quality Standards.

Average Daily Traffic: the average number of vehicles passing a specified point during a 24-hour period.

Baseline: the existing characterization of an area under no-project conditions.

Capacity: in transportation studies, the maximum number of vehicles having a reasonable expectation of passing over a given section of a lane or a roadway in one direction (or in both directions for a two-lane or a three-lane highway) during a given time period under prevailing roadway and traffic conditions.

Cartesian Coordinates: coordinates that locate a point on a plane by its measured distance from two straight-line axes which intersect each other at right angles.

Climate: the prevalent or characteristic meteorological conditions, and their extremes, of any given location or region.

Climatology: the science that deals with climates and their phenomena.

Count (Traffic): a number of moving vehicles, which may be used for comparison with the present traffic volume assigned to the corresponding link. The count may be directional or total two-way, peak hour morning and/or afternoon, and/or a 24-hour value.

Critical Intersections: roadway intersections classified as level of service E (highly congested) where there is a potential for exceeding the carbon monoxide (CO) ambient air quality standards from vehicular emissions.

Diurnal Temperature Ranges: the daily range of temperature extremes (i.e., highest, lowest) for any designated seasonal period or period of study.

Effect: a change in an attribute. Effects can be caused by a variety of events, including those that result from project attributes acting on the resource attribute (direct effect); those that do not result directly from the action or from the attributes of other resources acting on the attribute being studied; those that result from attributes of other projects or other attributes that change due to other projects (cumulative effects); and those that result from natural causes (e.g., seasonal change).

Effective Stack Height: the height to which a hot buoyant plume will rise when released from a point source. This height is dependent on the ambient air temperature, the height of the mixing layer, and the characteristics of the plume.

Emission Factor: the rate at which a pollutant is emitted from a point, line, or area source.

Fugitive Dust Emissions: emissions released directly into the atmosphere, which could not reasonably pass through a stack, chimney, vent, or other functionally equivalent opening.

Gaussian Diffusion: the dispersion of a plume from the centerline corresponding to normal distribution (bell-shaped).

Geometric Mean: the nth root of the product of n numbers.

Heavy-Duty Vehicle: a vehicle having three or more axles and designated for the transportation of cargo. Generally, the gross vehicle weight is greater than 26,000 pounds.

Impact: an assessment of the meaning of changes in all attributes being studied for a given resource, an aggregation of all the effects, usually measured using a qualitative and nominally subjective technique.

Inversion: a reversal of the normal atmospheric temperature gradient causing increasing temperatures with height.

Level of Impact: for each environmental resource and its elements, there are specific definitions for negligible, low, moderate, and high impacts for this EPTR.

Level of Service: in transportation studies, a qualitative measure of the flow of traffic along a given road in consideration of a wide variety of factors, including speed and travel time, traffic interruptions, and freedom to maneuver. Levels of service are designated A through F, A being a free-flow condition with low volumes and high speeds, and F being a congested condition of low speeds and stop-and-go traffic. Intermediate levels describe conditions between these extremes.

Light-Duty Vehicle: an automobile or light truck with two axles and four wheels, designed primarily for transportation of nine or fewer passengers (automobiles) or for transportation of cargo (light trucks). Generally, the weight is less than 10,000 pounds.

Long Term: denotes the steady-state operations phase of the project when a constant level of project employment is attained.

Long-Term Impact: after the construction phase and during full operation, an impact occurring from 1990 on.

Mean: a value that is computed by dividing the sum of a set of terms by the number of terms (i.e., average).

Medium-Duty Vehicle: a vehicle having two axles and six wheels designed for the transportation of cargo. Generally, the gross vehicle weight is greater than 10,000 pounds but less than 26,000 pounds.

Mesoscale: pertaining to a medium scale distance. For air pollution analysis, this usually covers a distance of up to approximately 100 miles.

Meteorology: the scientific study of the atmosphere.

Microscale: pertaining to a relatively small distance. For air pollution analysis, this is usually limited from several hundred feet to a few miles.

Milligram: one-thousandth of a gram.

Mitigations: methods to reduce or eliminate adverse project impacts.

Mixing Height: the height of the atmospheric layer in which convection and mechanical turbulence promote mixing.

Mobile Home: a dwelling unit which is transportable in one or more sections, built on a permanent chassis, and designed to be used with or without a permanent foundation. Does not include travel trailers or recreational vehicles.

Mobile Source: mobile air pollution sources are comprised of all air, water, and land transportation vehicles.

Model: a mathematical formula that expresses the actions and interactions of the elements of a system in such a manner that the system may be evaluated under any given set of conditions.

Nonattainment Area: an area that has been designated by the United States Environmental Protection Agency (EPA) and the appropriate state air quality agency as exceeding one or more National Ambient Air Quality Standards.

Pasquill Gifford Stability Classes: measures of atmospheric stability ranging from A-F (1-6) where stability class A-C (1-3) represents an unstable atmosphere, D (4) a neutral atmosphere, and E-F (5-6) a stable atmosphere.

Peak Hour: the 60 minutes observed during either the morning or evening peak traffic period that contains the largest amount of traffic.

Peak Period: the two consecutive morning or evening 60-minute periods that collectively contain the maximum amount of morning or evening travel. Peak period can be associated with person-trip movement, vehicle-trip movement, or transit trips.

Peak Year: the year in which some particular project-related effect, e.g., total employment, is greatest.

Plume: the theoretical cloud of pollutant emitted from a source (e.g., stack, exhaust pipe).

Plume Rise: the elevation a plume rises following emission from a source. The elevation is dependent upon ambient air temperature, height of the mixing layer, and plume temperature and density.

Point Source: any single source of air emissions from a stack, chimney, vent, or other functionally equivalent opening.

Polar Coordinates: coordinates that locate a point in space on a plane by its vector (direction and magnitude).

Prevention of Significant Deterioration: air quality regulations intended to maintain air quality by regulating the amount of further deterioration. Land areas are designated as Class I, II, or III according to the amount of allowable further degradation.

Prevention of Significant Deterioration Class I Areas: land areas in which existing air quality is to be most stringently maintained.

Queue Length: length of vehicles backed up at a signalized intersection during the red cycle period.

Region of Influence: the largest region which would be expected to receive measurable impacts from the project.

Rural: that area outside of towns, cities, or communities; characterized by very low density housing concentrations, agricultural land uses, and general lack of most public services.

Short-Term Impact: impact generated during the construction period; up to 1990.

Significance: the importance to the resource of the impact on the resource. Council of Environmental Quality (CEQ) regulations specify several tests to determine whether an action will significantly affect the quality of the human environment. While these tests apply to the entire action, they can also be used in an amended form to judge impact significance for individual resources. It is important to note that a high impact may not be significant, while a low impact may. Significance is an either/or determination: the level of impact described either is significant or is not significant. Additionally, beneficial significance must be determined at the same level as adverse significance. As specified in the CEQ regulations, significance needs to be determined for each of three geographic areas: local, regional, and national. This places the impact into context. Significance is also determined in terms of intensity.

Stability: in relation to air pollution disciplines, the property of the atmosphere that causes it, when disturbed from a condition of equilibrium, to develop forces or movements that restore the original condition.

Stack Downwash: concentration of stack emissions mixed downward in the region adjacent to the stack due to turbulent wind patterns formed by obstructions to the airflow around the stack and adjacent structures.

Star Data: statistical method of defining the distributions of atmospheric stability and wind direction.

Surface Roughness: a measure of the irregularity of the terrain used to determine the extent of turbulent mixing near the land surface from a body of air passing over the terrain.

Unavoidable Adverse Impact: a project-induced effect determined to be adverse that cannot, and hence will not, be mitigated or avoided.

Urban: descriptive of an area within towns, cities, or communities, characterized by densities greater than one dwelling unit per acre.

Visibility Degradation: any adverse change in visibility consisting of either a reduction of visual range from some reference value, or a reduction in contrast between an object and the horizon sky, or a shift in coloration or light intensity of the sky or distant objects compared to what is perceived on a "clear day".

Worst Case: the combination of all the worst possible effects to result potentially from the actions of a project.

4.2 Acronyms

ACS	Area of Concentrated Study
AF	Air Force
AFB	Air Force Base
AFRCE	Air Force Regional Civil Engineer
AFRCE-BMS	Air Force Regional Civil Engineer - Ballistic Missile Support
CDH	Colorado Department of Health
CFR	Code of Federal Regulations
CO	Carbon Monoxide
DA	Deployment Area
DAR	Defense Access Road
DEIS	Draft Environmental Impact Statement
EFLS	Equivalent Finite Line Source
EIS	Environmental Impact Statement
EPA	United States Environmental Protection Agency
EPTR	Environmental Planning Technical Report
EXP	Exponent
FEIS	Final Environmental Impact Statement
HC	Hydrocarbons
HDV	Heavy-Duty Vehicle
LDV	Light-Duty Vehicle
LF	Launch Facility
NDEC	Nebraska Department of Environmental Control
NO_2	Nitrogen Dioxide
NO_x	Oxides of Nitrogen
O_3	Ozone
Pb	Lead
ROI	Region of Influence
SO_2	Sulfur Dioxide
SO_x	Oxides of Sulfur
S/T	Stage Transporter
TSP	Total Suspended Particulates
USAF	United States Air Force
USAFR	United States Air Force Reserve
VMT	Vehicle Miles Traveled
VOC	Volatile Organic Compounds
WDEQ	Wyoming Department of Environmental Quality

4.3 Units of Measurement

Btu	British thermal unit
Btu/lb	British thermal units per pound
°C	degrees Celsius
cm	centimeter
cy	cubic yard
cy/day	cubic yards per day
cy/vehicle	cubic yards per vehicle
°	degrees (temperature)
ft	foot (feet)
ft/day	feet per day
g	gram
g/lb	grams per pound
g/m^3	grams per cubic meter
g/mi	grams per mile
g/sec	grams per second
hr	hour
hr/day	hours per day
km	kilometer
km/hr	kilometers per hour
kW	kilowatt
kWh	kilowatt hour
lb	pound
lb/cf	pounds per cubic feet
lb/cy	pounds per cubic yard
lb/day	pounds per day
lb/hr	pounds per hour
lb/T	pounds per ton
lb/VMT	pounds per vehicle mile traveled
m	meter
m^2	square meter
m^3	cubic meter
MBtu	million British thermal units
mg	milligrams
mg/m^3	milligrams per cubic meter
mi	mile
mph	miles per hour
m/sec	meters per second
MT	metric tons
MT/day	metric tons per day
ppm	parts per million
sec	seconds
sq ft	square foot (feet)

T/acre/yr	tons per acre per year
T/cy	tons per cubic yard
T/yr	tons per year
u	microns
ug/m^3(μg/m^3)	micrograms per cubic meter

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APPENDIX A
AIR QUALITY MODEL DESCRIPTIONS

A.1 CALINE 3

CALINE 3 (Federal Highway Administration 1979) is a computerized line source air quality dispersion model developed by the California Department of Transportation and approved by both the United States Environmental Protection Agency (EPA) and the Federal Highway Administration to calculate ground level concentrations of carbon monoxide (CO) from vehicular emissions. The model is based on Gaussian diffusion equations and employs a mixing zone concept to characterize pollutant dispersion over the roadway. Given source strength, meteorology, site geometry, and site characteristics, the model can reliably predict pollutant concentrations for receptors located within 150 meters of the roadway.

CALINE 3 divides individual highway links into a series of elements from which incremental concentrations are computed and then summed to form a total concentration estimate for a particular receptor location. The receptor distance is measured perpendicularly from the receptor to the highway centerline. Each element is modeled as an equivalent finite line source (EFLS) positioned normal to the wind direction and centered at the element midpoint. A local x-y coordinate system aligned with the wind direction and originating at the element midpoint is defined for each element. The emissions occurring within an element are assumed to be released along the EFLS representing the element. The emissions are then assumed to disperse in a Gaussian manner downwind from the element. The length and orientation of the EFLS are functions of the element size and the angle between the average wind direction and highway alignment.

In order to distribute emissions in an equitable manner, each element is divided into five discrete subelements represented by corresponding segments of the EFLS. The use of five subelements yields reasonable continuity to the discrete element approximation used by the model while not excessively increasing the computational time. The source strength for the segmented EFLS is modeled as a step function whose value depends on the subelement emissions. The emission rate per unit area is assumed to be uniform throughout the element for the purposes of computing this step function. The size and location of the subelements are a function of element size and wind angle.

CALINE 3 treats the region directly over the highway as a zone of uniform emissions and turbulence. This is designated as the mixing zone, and is defined as the region over the traveled way (traffic lanes - not including shoulders) plus 3 meters on either side. The additional width accounts for the initial horizontal dispersion imparted to pollutants by the vehicle wake effect.

Within the mixing zone, the mechanical turbulence created by moving vehicles and the thermal turbulence created by hot vehicle exhaust are assumed to predominate near the ground. Evidence indicates that this is a valid assumption for all but the most unstable atmospheric conditions. Since traffic emissions are released near the ground level and model accuracy is most important for neutral and stable atmospheric conditions, it is reasonable to model initial vertical dispersion as a function of the turbulence within the mixing zone.

CALINE 3 permits the specification of up to 20 roadway links and 20 receptors within an X-Y plane (not to be confused with the local x-y coordinate system associated with each element). A link is defined as a straight segment of roadway having a constant width, height, traffic volume, and vehicle emission factor. The location of the link is specified by its end point coordinates. The location of a receptor is specified in terms of X, Y, and Z coordinates. Thus, CALINE 3 can be used to model multiple sources and receptors, curved alignments, or roadway segments with varying emission factors. The wind angle inputs to the model follow accepted meteorological convention (i.e., 90, equivalent to a wind directly from the east).

The program automatically sums the predicted CO contributions from each link to each receptor. After this has been completed for all receptors, an optional ambient or background value assigned by the user is added. Surface roughness is assumed to be reasonably uniform throughout the study area. The meteorological variables of atmospheric stability, wind speed, and wind direction are also taken as constant over the study area. This assumption of horizontal homogeneity is important when assigning link lengths.

A.2 MOBILE 2

MOBILE 2 (EPA 1981a) is an integrated set of computerized algorithms used to analyze the air pollution impact of highway mobile sources. MOBILE 2 computes emissions from highway motor vehicles utilizing the most recent emission factors and calculative methodologies developed by the EPA. These factors and the associated methodologies follow those published in Compilation of Air Pollutant Emission Factors: Highway Mobile Sources (EPA 1981c).

MOBILE 2 computes emission factors for three pollutants, hydrocarbons, CO, and oxides of nitrogen based upon the specific vehicular mix utilized as input. The vehicle mix is the specific percentage of light-duty vehicles (gas and diesel), light and heavy-duty trucks (gas and diesel), and motorcycles representative of the roadway under study.

The MOBILE 2 program computes emission estimates for Low Altitude (49-State or Non-California) Regions, California (Low Altitude) Regions, and High Altitude (49-State or Non-California) Regions.

MOBILE 2 calculates emission estimates for January 1 of any calendar year 1970 through 2020. The emission estimate of each calendar year is based on vehicular exhaust characteristics of the 20 most recent years.

The basic exhaust emission rates included in MOBILE 2 are generated from tests conducted on vehicles or engines under standardized test conditions representative of urban driving. As such, the basic exhaust emission rates in MOBILE 2 represent those standardized test conditions. These conditions for the different vehicle types are given in specific detail in various Codes of Federal Regulations (40 Part 86 July 1, 1976, 1978, 1979, and 1980).

Further, the MOBILE 2 basic exhaust emission rates assume that 1) air conditioners are not in use, 2) vehicles are not towing trailers or carrying extra loads, 3) no inspection/maintenance program is in effect, and 4) owners perform (or have performed) average maintenance on the vehicles. Corrections can be made, however, in the input data to account for the inclusion of these factors, if appropriate.

MOBILE 2 has three options specific to the calculation or output of hydrocarbon emissions. MOBILE 2 can calculate either total or nonmethane hydrocarbon emissions. In addition to the calculated hydrocarbon emissions (which include crankcase and evaporative hydrocarbon emissions), MOBILE 2 has the capability to output crankcase and evaporative hydrocarbon emission factors for each vehicle type in units of grams per mile. The crankcase and evaporative hydrocarbon emission levels depend upon miles per day and trips per day data. For each vehicle type, MOBILE 2 can utilize input data of miles per day and trips per day data representative of the particular area being analyzed.

As an option, MOBILE 2 can generate idle exhaust emission factors for the different vehicle types. These idle emission factors represent a vehicle in a hot stabilized condition and are given in grams per minute.

To calculate the January 1 calendar year emissions for each vehicle type, MOBILE 2 appropriately weights the 20 most recent model years together. These model year weights are known as the travel weighting fractions. The travel weighting fractions for a given vehicle type are a distribution of the total vehicle miles traveled (VMT) by the vehicle type apportioned among the 20 most recent model years. The travel fractions account for both the January 1 registration and fleet annual mileage accumulation rate distributions for the given vehicle type. Further, the expected increase in diesel sales by model year is taken into account for the light-duty vehicle and truck fleets.

Adjustments can be made to the basic exhaust emission levels to more accurately estimate vehicle emissions to model scenarios which do not conform to the basic test conditions. Therefore, MOBILE 2 computes and applies correction factors for speed, ambient temperature, and vehicle operating modes to reflect the scenarios being analyzed. (The operating modes are the percentage of the VMT driven by a vehicle type in a cold start, stabilized, and hot start condition.) These correction factors are applied only to the basic exhaust emissions, not the crankcase and evaporative hydrocarbon emissions or the idle emissions.

As an option, MOBILE 2 allows the user to include the effect of four additional correction factors for light-duty gasoline-powered automobiles and trucks. These correction factors are segregated from those previously described because they represent unique conditions which are often not assumed in MOBILE 2 applications. These four factors for light-duty gasoline powered automobiles and trucks are 1) air conditioning; 2) extra load; 3) trailer towing; and 4) oxides of nitrogen humidity (also applied to motorcycles).

These additional correction factors impact only the basic exhaust emission levels.

MOBILE 2 allows the user to apply inspection and maintenance credits to the basic exhaust and idle emission levels. The emission reduction credits attributable to an inspection/maintenance program vary according to the type of program in effect.

A.3 Climatological Dispersion Model - Wyoming

The Climatological Dispersion Model - Wyoming (WDEQ 1983c), a version of the EPA Climatological Dispersion Model (EPA 1973) was developed with the purpose of making the EPA annual model applicable to a rural environment. The computerized Climatological Dispersion Model - Wyoming provides estimates of long-term concentrations of nonreactive pollutants due to emissions from area and point sources. Two pollutants may be considered simultaneously, the most frequent application being for sulfur dioxide and particulate matter.

In the Climatological Dispersion Model - Wyoming, area sources are calculated using the narrow plume hypothesis (Gifford and Hanna 1971) applied for winds within a sector (Calder 1971) which involve an upwind integration over the area sources.

In the Climatological Dispersion Model, emission rates at various upwind distances using an expanding scale, are averaged over an arc within the sector. A power law for the vertical wind profile which is a function of stability is used to extrapolate surface winds to the source height. Estimation of the effective plume height of point sources is determined by Briggs' plume rise equations (Briggs 1969). The Climatological Dispersion Model was modified by Wyoming to allow the calculation of plume rise in the stable conditions by incorporation of a Briggs stable plume rise formula. Briggs' neutral-unstable plume rise equations were also modified (WDEQ 1982d).

A rectangular grid array of uniform-sized squares is used to overlay the region of interest. The main purpose of this grid is to catalog the emission inventories by area sources. The original Climatological Dispersion Model program was dimensioned to accept a 50 by 50 array of area sources. The Climatological Dispersion Model - Wyoming program is dimensioned to accept a 100 by 100 array of area sources.

The model requires information on the joint frequency function as input for the model. This function gives the joint frequency of occurrence of a wind direction sector, a wind speed class, and an atmospheric stability category index. There are 576 entries in the table for the joint frequency function. This number of values results from the 16 different wind vectors, 6 wind speed classes, and 6 stability classes used in determining the frequency function.

Weather observations are taken hourly by meteorologists of the National Weather Service at airports serving major urban areas and can be obtained from the National Climatic Data Center located in Asheville, North Carolina. The Day-Night version of the National Climatic Data Center program called STAR gives the proper form of the joint frequency function which may be used directly as input into the Climatological Dispersion Model. The model was modified by Wyoming to accept a straight six stability STAR program with no separation of Day and Night and the vertical dispersion parameters were associated directly with the STAR input. The original Climatological Dispersion Model required meteorological data input with each run. The Climatological Dispersion Model - Wyoming contains its own STAR data programs.

The Wyoming version of the Climatological Dispersion Model allows for more stable conditions to exist under rural conditions, which is consistent with the joint frequency input (STAR). The original Climatological Dispersion

Model program assumed the vertical dispersion function to be in the neutral or D stability class even when the STAR data indicated E or F stability. Since stable conditions are allowed to occur in the Climatological Dispersion Model - Wyoming, the mixing height scheme was modified to assume unlimited mixing height during stable conditions.

A.4 Single Source (CRSTER) Model

The computerized Single Source (CRSTER) Model (EPA 1977) was used as a screening procedure to search for the potential worst-case 24-hour meteorological sequences for assessing the 24-hour impacts of fugitive dust emissions. The CRSTER Model was developed by the EPA primarily to calculate the pollutant contributions from multiple elevated stack emissions at single-site rural locations in flat to gently rolling terrain. The program calculates concentrations for an entire year and prints out the highest and second-highest 1-hour, 3-hour, 24-hour, and annual mean concentrations at a set of 180 receptors surrounding the site. The model includes adjustments for plume rise, limited mixing height, and elevated terrain. Pollutant concentrations are computed from measured hourly values of wind speed and directions, and estimated hourly values of atmospheric stability and mixing height.

The CRSTER Model is based on a modified version of the Gaussian plume equation which was developed for a continuous emission source in order to calculate the local concentration of a gas or aerosol at a ground-level location. Modifications made to the basic Gaussian plume equation include: a) trapping of the plume between the top of the mixing layer and the ground surface, b) uniform vertical mixing of the plume within the mixing layer beyond a critical distance, and c) exclusion of any ground level impacts from plumes released above the mixing layer. Additional assumptions incorporated in the equation are summarized below:

- Steady-state conditions - ideal gas, continuous uniform emission rate, homogeneous horizontal wind field, representative hourly mean wind velocity, no directional wind shear in the vertical, infinite plume, and no plume history.

- Pollutant characteristics - the pollutant emitted is a stable gas or aerosol which remains suspended in the air and participates in the turbulent movement of the atmosphere; none of the material is removed as the plume advects and diffuses downwind, and there is complete reflection at the ground.

- Gaussian distribution - the pollutant material within the plume takes on a Gaussian distribution in both the horizontal crosswind and vertical directions.

The Gaussian plume equation uses empirical dispersion coefficients developed by Pasquill (1974) and Gifford (1961) to determine downwind concentrations of the plume gas or aerosol. The dispersion coefficients are represented as a function of downwind distance from the emissions source and the atmospheric stability. The atmospheric stability is calculated by the model based on methods developed by Turner which incorporate cloud cover, ceiling height, wind speed, and solar elevation (Turner 1970). The atmospheric stability is then classified into six categories from extremely unstable to moderately stable according to the Pasquill classification scheme.

CRSTER's preprocessor program calculates the stability classification and dispersion parameters for each hour of record from recorded surface and upper air meteorological observations.

A.5 Industrial Source Complex - Short Term

The computerized Industrial Source Complex Dispersion model (EPA 1979b) combines and enhances various dispersion model algorithms into a computer program that can be used to assess the air quality impact of pollutants from the wide variety of sources associated with an industrial source complex. For plumes comprising particulates with appreciable gravitational settling velocities, the Industrial Source Complex model accounts for the effects on ambient particulate concentrations of gravitational settling and dry deposition. Alternately, the Industrial Source Complex model can be used to calculate dry deposition. The Industrial Source Complex - Short Term model is designed to calculate concentration or deposition values for time periods of 1, 2, 3, 4, 6, 8, 12, and 24 hours. If used with a year of meteorological data, the Industrial Source Complex - Long Term model can calculate annual concentration or deposition values.

The Industrial Source Complex model's programs accept the following source types: stack, area, and volume. The volume source option is also used to simulate line sources. The steady-state Gaussian plume equation for a continuous source is used to calculate ground-level concentrations for stack and volume sources. The area source equation in the Industrial Source Complex model's programs is based on the equation for a continuous and finite crosswind line source. The generalized Briggs (1971, 1975) plume-rise equations, including the momentum terms, are used to calculate plume rise as a function of downwind distance. Procedures suggested by Huber and Snyder (1976) and Huber (1977) are used to evaluate the effects of the aerodynamic wakes and eddies formed by buildings and other structures on plume dispersion. A wind-profile exponent law is used to adjust the observed mean wind speed from the measurement height to the emission height for the plume rise and concentration calculations. Procedures utilized by the CRSTER model are used to account for variations in terrain height over the receptor grid. The Pasquill-Gifford curves (Turner 1970) are used to calculate lateral (σ_y) and vertical (σ_z) plume spread. The Industrial Source Complex model has rural and urban options. In the rural mode, rural mixing heights and the σ_y and σ_z values for the indicated stability category are used in the calculations. In urban mode 1, the E and F stability categories are redefined as neutral D stability. In urban mode 2, the E and F stability categories are combined and σ_y and σ_z values for the stability category that is one class more unstable then the indicated stability category (except A) is used in the calculations. Urban mixing heights are used in both urban modes. The model's meteorological preprocessor program for determining stability and dispersion parameters from upper air and surface observations is identical to that of CRSTER.

A.6 Visibility Screening Procedure

The EPA Visibility Workbook analysis procedure (EPA 1980b) is designed to provide technical guidance in determining the potential impacts of an emissions source on Prevention of Significant Deterioration Class I area visibility.

The level 1 visibility screening analysis procedure is a straightforward calculation designed to identify those emissions sources that have little potential of adversely affecting visibility in a Class I area. If a source passes this first screening test, it would not be likely to cause adverse visibility impairment, and further analysis of potential visibility impacts would be unnecessary. If the source fails this test, additional screening analysis would be needed to assess potential impacts.

The input parameters needed to evaluate potential visibility impacts with this screening analysis procedure are as follows:

- Minimum distance of the emissions source from a potentially affected Class I area;
- Location of the emissions source and Class I area; and
- Particulate, oxides of nitrogen and sulfur dioxide emission rates in metric tons per day (MT/day).

The level-1 visibility screening analysis is designed to evaluate two potential types of visibility impairment that can be caused by plumes from emissions sources. These two types of visibility impairment are caused by oxides of nitrogen, particulate, and sulfur dioxide emissions. One is a discolored, dark plume observed against a bright horizon sky. This effect is caused principally by nitrogen dioxide gas formed from oxides of nitrogen emissions and particulates. The other type is a bright plume observed against a dark terrain viewing background. This effect is caused principally by particulate emissions and sulfate aerosols formed from sulfur dioxide emissions.

Model calculations (Latimer 1980) suggest that sulfate aerosols do not form in stable plumes containing a significant amount of oxides of nitrogen. Sulfate formation does not occur until emissions are diluted significantly with background air. However, the visual impact caused by oxides of nitrogen and particulate emissions are greatest when the plume material is concentrated as in light-wind, stable conditions. For these reasons, two different meteorological conditions are considered:

- For maximum impact caused by particulate and oxides of nitrogen emissions: stable (Pasquill-Gifford stability category F), light-wind conditions with a 12-hour transport time to the closest Class I area;
- For maximum impact caused by sulfur dioxide emissions: limited mixing conditions, vertically well-mixed plume within a 1,000 meter mixing depth, and a 2-meters per second (m/sec) wind speed.

The plume is assumed to pass very close to the observer with its centerline half the width of a 22.5 degree sector away from the observer at a given downwind distance. The observer's line of sight is assumed to be perpendicular to the plume centerline. The viewing background is assumed to be either the horizon sky or a black terrain object located on the opposite side of the plume, a distance equivalent to a full sector from the observer.

APPENDIX B

APPENDIX B
AIR QUALITY ASSUMPTIONS

B.1 Introduction

This appendix presents the assumptions that have been employed in conjunction with the models and/or methodologies that were used to assess the existing baseline air quality conditions and future trends and project impacts. Assumptions include those which were incorporated into the models as well as assumptions that were made in applying the models to the project area.

B.2 CALINE 3 Analysis

The CALINE 3 computerized model was used to determine dispersion of vehicular emissions of carbon monoxide (CO) at receptor locations adjacent to major roadway corridors and intersections. Many of the assumptions employed represent user options in selecting the meteorological and roadway description parameters to be used by the model. The assumptions are as follows:

- For peak 1-hour calculations, a wind speed of 1 meter per second (m/sec) and stability class 5 (slightly stable) were used. These meteorological parameters are typically used in modeling to represent the stagnant, stable atmospheric conditions that represent a worst-case condition because they minimize the dispersion of pollutant emissions.

- For 8-hour calculations, a wind speed of 2 m/sec and stability class 4 (neutral) were used. These parameters are typically used in modeling to represent a worst-case condition for an 8-hour period. Pollutant dispersion is slightly better than for the 1-hour calculations because the wind speed and stability class used for the 1-hour worst-case situation are highly unlikely to occur continuously for an 8-hour period.

- An atmospheric mixing height of 1,000 meters was used. Although specific mixing height data are available for the Cheyenne area, it is usually input into regional models. CO dispersion, on a microscale level, does not vary significantly with mixing heights which range from 100 to 1,000 meters. Because of the uncertainty of correlation of the mean measured mixing heights with peak traffic periods, the variation of mixing height for 1 hour and 8-hour periods, and the lack of sensitivity for mixing heights with those ranges, a standard default value of 1,000 meters was used.

- A value of 50 centimeters (cm) was used in the model to approximate the surface roughness of lightly populated areas. The distances between homes, as well as the fields which surround them, were a factor in selecting this parameter which is midway between CALINE 3 guidelines for grass meadows and single-family residential areas. The single-family residential value of 108 cm was used in more populated housing areas while the business district value of 175 cm was used for the more urbanized intersections.

- All roadways were assumed to be level and at-grade. This assumption is based on field trips and on average conditions over the length of the roadway links that were modeled.

- Background air quality levels for CO were assumed to be 1.0 part per million (ppm) for the peak 1-hour period and 0.5 ppm for the 8-hour period. These values were used because no CO monitoring has been conducted in the Cheyenne area; 0.5 ppm represents the minimum accurately detectable level of most CO analyzers.

- The model's ±3 meter wake effect for initial horizontal dispersion was not included for intersection analysis due to the low average vehicular speeds.

B.3 MOBILE 2 Analysis

The MOBILE 2 computerized model was used to calculate vehicular emission factors (i.e., individual vehicular source strengths for CO) for use in the CALINE 3 dispersion modeling. The following assumptions were employed:

- One-hour emission factors were calculated using the average minimum temperature in January of 14.8°F for the Cheyenne area (U.S. Department of Commerce 1982). The average winter minimum temperature is a standard reference point for calculating a worst-case condition for a 1-hour period because pollutant emissions are greater during the longer warm-up period of engines in cold weather. Futhermore, the minimum temperature typically occurs in the early morning hours, generally during the period of peak traffic. The atmospheric conditions tend to be more stable in the morning, which slows pollutant dispersion.

- Eight-hour emission factors were calculated using the average daily temperature in January of 26.1°F for the Cheyenne area (U.S. Department of Commerce 1982). This value represents the average cold weather conditions over a 24-hour period.

- Inspection/maintenance credits were not incorporated into the emission factor calculations because Wyoming and Nebraska do not have an inspection/maintenance program for motor vehicle pollutant emissions.

- High-altitude national mix was used for vehicle registration and the mileage accrual calculation in the model because this is appropriate to the project area.

- Diesel mix was based on sales tables and guidelines in MOBILE 2 because information specific to the project area were unavailable.

- Future percentages of trucks were the same as existing percentages. Precise data on future truck percentages was unavailable but it was estimated that the construction truck traffic would increase approximately in proportion to increased worker light-duty vehicle traffic.

- Truck percentages are higher for 8-hour periods than for 1-hour periods on highways and major arterials.

- Hot/cold start mixes were set at 10 percent for the peak 1-hour calculations and 5 percent for the 8-hour calculations for the highway road links. For lack of specific data, these values were estimated based on percentages from other states.

- Hot/cold start mixes were set at 30 percent for the 1-hour calculations and 20 percent for the 8-hour calculations for the residential road links. For lack of specific data, these values were estimated based on percentages from other states.

- Vehicular speeds used on all uninterrupted flow roadways were assumed to equal the posted limit for both 1-hour and 8-hour time periods. The low initial volumes, combined with the relatively low additional vehicular loading for future trends and the project, should have minimal impact on traveling conditions.

- Vehicular speeds used on all intersections were 10 miles per hour (mph) and 15 mph for 1-hour and 8-hour periods, respectively. These speeds reflect the cruise, deceleration, stopping, and acceleration conditions of an intersection.

- Pollutant emissions from future motor vehicles were presumed to decrease due to advanced technology and compliance with federal Clean Air Act regulations.

B.4 CRSTER Analysis

The CRSTER computerized model was used in conjunction with the Industrial Source Complex - Short Term model to determine the combination of meteorological conditions that would yield a worst-case assessment of 24-hour fugitive dust emissions. However, since CRSTER is a point source model, modifications to the programs and certain assumptions were made to most closely represent an area source for fugitive dust calculations. A list of the modifications and assumptions that were employed with this model are:

- Effective stack height of 10 meters is representative of initial dispersion release height from construction activities;

- Priority is given to minimum distance receptors at 0.5 kilometers (km) due to their proximity to pollutant sources. Priority is also given to Class I/Category I areas due to the sensitivity of these areas to increases in pollutant concentrations;

- The project area topography is flat;

- There is no stack downwash due to minimum interference from other structures around the pollutant sources;

- No deposition or settling of particulates were assumed due to the unavailability of site-specific particulate size distribution characteristics;

- Standard Pasquill and Gifford stability classes, an accepted determinati-n of stability classification, were used;

- There was no seasonal adjustment of emissions due to unavailability of specific data;

- A point source model was used to simulate an area source;

- A 5-year period of meteorological data (1960 to 1964) from Cheyenne Airport was used to determine the worst-case anticipated pollution episodes for the project area. This is the only current, consecutive period of time that hourly surface and upper air data are available from the National Climatic Data Center for input into this model; and

- Since upper air data is not recorded at the Cheyenne Airport, Denver's Stapleton Airport mixing height data were used to represent atmospheric stability conditions for the project area.

B.5 Industrial Source Complex - Short Term Analysis

The Industrial Source Complex - Short Term computerized model was used to determine daily (24 hour) fugitive dust concentrations. The assumptions that were employed with the model are:

- Five-meter initial dispersion release height. This is representative of the initial height of a dust plume from construction activities;

- No deposition or settling of particulates, because the equations used to determine the emission factors were based on particulate sizes of less than 30 microns which would remain suspended out to the distance that the receptors are located;

- Use of standard Pasquill and Gifford stability classes, an accepted determination of stability classification; and

- The worst-case pollution episodes from point source emissions based on the CRSTER model are also the worst-case pollution episodes from area sources.

B.6 Climatological Dispersion Model - Wyoming Analysis

The Climatological Dispersion Model - Wyoming computerized model was used to determine annual fugitive dust concentrations at various directions and distances downwind from pollutant sources. Assumptions that were employed with this model are as follows:

- All area sources can be simulated by a series of 500-meter square grids (WDEQ 1982d);

- Ten-meter initial dispersion release height. This is representative of the initial height of a dust plume from construction activities;

- No deposition or settling of particulates due to the u/availability of site-specific particulate size distribution characteristics;

- No seasonal adjustment of emissions; emissions were averaged over an annual period;

- Flat terrain;

- A 5-year period of meteorological data (1960 to 1964) from Cheyenne Airport was used to determine the worst-case anticipated pollution episodes for the project area. This is the only current, consecutive period that hourly surface and upper air data are available from the National Climatic Data Center for input into this model;

- Morning mixing heights of 300 meters and an afternoon mixing height of 2,000 meters to be representative of average conditions. Information was acquired from the Wyoming Department of Environmental Quality (WDEQ) (1983c).

- Anemometer height of 10 meters. This is the standard height at which the wind parameters are measured; and

- Ambient atmospheric temperature of 40°F. This is the mean annual temperature for Cheyenne and it is assumed that this is sufficient to account for varying climatic conditions annually.

B.7 Visibility Analysis

The United States Environmental Protection Agency (EPA) procedure was used to determine visibility impairment at various Class I/ Category I areas due to gaseous and particulate emissions. Assumptions that were employed with this procedure are as follows:

- No complex terrain due to the area's flat to generally rolling terrain;

- The plume would pass very close to the observer and the line of sight is perpendicular to the plume centerline;

- The viewing background is optimal (i.e., greatest contrast); and

- The chosen receptor location would have at least one 12-hour period where it is continuously downwind of the source.

B.8 Fugitive Dust Analysis

Fugitive dust emission rates were calculated for area sources. Area sources include emissions from travel on unpaved roads, trenching operations, grading roadway surfaces, dumping of overburden and gravel material, and building construction activities. The assumptions which entered into this analysis are as follows:

- Emissions were calculated for peak construction periods based on projected construction schedules.

- Quantities of disturbed land surfaces at F.E. Warren AFB were based on estimated building floor space and roadway lengths.

- Construction activity would occur 5 days a week, rain or shine, 8-hours a day (except on holidays).

- Emission factors were averaged over an annual period for Climatological Dispersion Model - Wyoming with no seasonal adjustment.

- Quantities of disturbed land surfaces for the project-induced housing construction were calculated based on the projected number of housing units.

- Silt content of the soil is approximately 19 percent and moisture content is approximately 5 percent for the project area (U.S. Soil Conservation Service 1983).

- Silt content of unpaved road surfaces is approximately 12 percent (EPA 1981b).

- Additional specific numeric assumptions used in the analytic calculations are given in Appendix C (Emission Factor and Visibility Screening Calculations).

B.9 Emissions Analysis

Regional baseline and project-related total emissions of total suspended particulates, oxides of sulfur, oxides of nitrogen, CO, and volatile organic compounds were calculated for the project area. The assumptions used in the analytic calculations are given in Appendix D (Regional and Project-Related Emissions).

APPENDIX C

APPENDIX C
EMISSION FACTOR AND VISIBILITY SCREENING CALCULATIONS

C.1 Calculations of Fugitive Dust Emission Factors

C.1.1 Introduction

The following discussion presents the methodologies used in developing estimated fugitive dust emission factors from project-related construction activities for input into the dispersion models and visibility screening procedures as discussed in Appendix A. Both annual and 24-hour emission factors were calculated for use as input in modeling to determine impacts on the ambient air quality. Emission factors were determined for the periods of projected maximum construction in order to analyze potential worst-case construction activities.

Emission factors were calculated for each of the following construction activities:

- Construction and modification of buildings and roadways at F.E. Warren AFB;
- Construction of project-induced housing units;
- Resurfacing Deployment Area (DA) roads;
- Installation of communication cables;
- Modification of the Launch Facility (LF) site pads and upgrade of the LF access roads; and
- Activity at dispatch stations.

Twenty-four hour emission rates were calculated for each of these construction activities; however, annual emission rates were only calculated for those construction activities that are expected to occur for 1 or more years at any 1 location. All construction-related emission factors incorporate the use of dust control mitigation measures, assuming a 50 percent control efficiency in reduction of fugitive emissions.

Data and assumptions used for the emission rates calculations were obtained from AP-42 (EPA 1981b, 1982), Wyoming State Emission Factors from Mining Operations (WDEQ 1979), and engineering reports on public works and heavy construction schedules and costs (Dodge Guide 1981).

C.1.2 Construction of New Buildings and Roadways on F.E. Warren AFB

Fugitive dust emissions from building construction activities on F.E. Warren AFB were based on the estimated total amount of expected disturbed acreage from direct construction activities of new operational facilities. The total amount of direct construction-related acreage disturbed was approximated by doubling the actual square footage of the proposed operational facilities. Remaining disturbed acreage was assumed to be affected by wind erosion only.

The emission factors were based upon the general construction emission factor of 1.2 tons per acre per month (T/acre/month) developed by the EPA (1981b), which was then adjusted to reflect the construction schedule based on 18 workdays per month. This emission factor was derived from monitoring similar construction activities at apartment complexes and shopping centers in which emissions from the following activities are incorporated: land clearing, ground excavation, cut and fill operations, facility construction, and equipment travel over temporary roadways.

The emission factor applies to construction operations with medium activity and moderate soil silt content in a semiarid climate. Fugitive dust control methods were also used when developing the 1.2 T/acre/month emission factor.

Annual emission rates were based on estimated construction work schedules and the amount of time during the peak construction year (1985) in which construction activities would be occurring. The total disturbed acreage for each facility was therefore adjusted for the percentage of actual land disturbed during the peak year as shown in Table C.1-1.

Table C.1-1

FUGITIVE DUST EMISSION RATES
(Annual)

Location	Total Disturbed Acreage (1984-1986)	Disturbed Acreage (1985)	Emission Rate (T/yr)
Stage Storage Area			
- Construction	5.08	4.83	3.48
- Erosion	2.58	2.58	0.59
Weapons Storage Area			
- Construction	2.68	2.37	1.71
- Erosion	9.72	9.72	2.24
Integrated Support Complex	8.64	6.57	4.73
Training and Instruction Facilities	2.72	2.4[illegible]	1.79

The amount of direct construction-related disturbed acreage in a 24-hour period was determined by dividing the total disturbed acreage during the peak year by 216 working days per year or by the total number of working days if the facility construction would be expected to be completed in less than 1 year. The 216 working days per year were based on a 5-day work week with 12 holidays and an expected 32 days lost to adverse weather conditions. The 1.2 T/acre/month emission factor was then adjusted for a 24-hour rate in the same manner. The amount of disturbed acreage subjected to wind erosion in a 24-hour period was determined by dividing the total erodible disturbed acreage during the peak year by 365 days or by the total number of calendar days of construction if it would be expected to be completed in less than 1 year. The 24-hour emission rate per construction area is shown in Table C.1-2.

Table C.1-2

FUGITIVE DUST EMISSION RATES
(24 Hours)

Location	Total Disturbed Acreage (1985)	Daily Disturbed Acreage	Emission Rate (T/day)
Stage Storage Area			
- Construction	4.83	0.022	0.0161
- Erosion	2.58	0.007	0.0016
Weapons Storage Area			
- Construction	2.37	0.011	0.0079
- Erosion	9.72	0.027	0.0061
Integrated Support Complex	6.57	0.040	0.0287
Training & Instruction Facilities	2.48	0.012	0.0090

Fugitive dust emissions from the estimated 7.5 miles of new roadway construction and 1.3 miles of roadway upgrades would be expected to cause the highest short-term air quality impacts from construction activities on the base. To determine the emission rate for roadway construction, each individual construction activity was analyzed separately. The individual activities analyzed were grading of roadway surfaces and equipment travel over unpaved roads.

Based on typical construction of asphalt paved arterial roadways, an average amount of material unloaded and paved in a day was estimated to be approximately 326 cubic yards (cy) for new roadway construction. It was assumed that a paver can travel 2,000 linear feet per workday, laying approximately 2.5 inches per pass. It would take 10 passes to lay 44 feet of roadway, 12 inches thick (8 inches of base and 4 inches of asphalt surface). Therefore, the paver could cover 200 feet per day.

- o Wind erosion of disturbed surfaces (Stage Storage Area)

  Emission factor = AIKCLV T/acre/yr

  A = proportion of suspended material, 0.01 (sandy soil type)
  I = soil erodibility, 134 (sandy soil type)
  K = surface roughness, 1.0
  C = climatic factor, 0.49
  L = field width factor, 0.7
  V = vegetative cover, 1.0

  Emission factor = 0.46 T/acre/yr

  Approximate disturbed area = 2.58 acres

  Emission rate = (0.46)(2.58) = 1.2 T/yr
  (with 50 percent fugitive dust control) = 0.6 T/yr

- o Wind erosion of disturbed surfaces (Weapons Storage Area)

  Approximate disturbed area = 9.72 acres

  Emission rate = (0.46)(9.72) = 4.5 T/yr
  (with 50 percent fugitive dust control) = 2.2 T/yr

For the upgrading of existing roadways to 24 feet wide and 12 inches thick, it was estimated that the paver could cover 400 feet per day.

Emission factors based on empirical equations developed by the EPA in AP-42 and also referenced in the Wyoming State Emission Factors from Mining Operations were developed for grading and land clearing of roadway surfaces and travel on unpaved roads. These emission rate calculations are presented below:

- o Grading and land clearing of roadway base (new and upgraded roadway)

  Emission factor = 32 lb/hr

  Emission rate (8-hr day): 256 lb/day
  (with 50 percent fugitive dust control) 128 lb/day

- o HDV travel on unpaved roads (new roadway)

  Emission factor = (0.81s) (S/30) (0.62) (W/4) lb/VMT

  s = silt content, 19 percent
  S = vehicle speed, 20 mph
  W = number of wheels, 10 wheels per dump truck
  VMT = vehicle miles traveled
  = (length road segment) (number of vehicles/day)
  = (200 ft) (18 vehicles/day) (mi/5,280 ft)
  = 0.68 vehicle-miles/day

  Number of vehicles per day : (326 cy/day)/(18 cy/vehicle) = 18 vehicles/day
  Emission rate = (0.81) (19) (20/30) (0.62) (10/4) (0.68) = 10.8 lb/day
  (with 50 percent fugitive dust control) = 5.4 lb/day

- o Heavy duty vehicle (HDV) travel on unpaved roads (upgraded roadway)

  Emission factor = (0.81s) (S/30) (0.62) (W/4) lb/VMT

  VMT = vehicle miles traveled
  = (length road segment) (number of vehicles/day)
  = (400 ft) (10 vehicles/day) (mi/5,280 ft)
  = 0.76 vehicle-miles/day

  Number of vehicles per day : (178 cy/day)/(18 cy/vehicle) = 10 vehicles/day
  Emission rate = (0.81) (19) (20/30) (0.62) (10/4) (0.76) = 12.1 lb/day
  (with 50 percent fugitive dust control) = 6.0 lb/day

- o Wind erosion of disturbed surfaces (new roadway)

  Approximate disturbed area =
  2 (7.5 mi x 5,280 ft/mi) (15 ft) (acre/43,560 sq ft)
  = 27.3 acres

  Emission rate = (0.46) (27.3) = 12.6 T/yr
  (with 50 percent fugitive dust control) = 6.3 T/yr

- o Wind erosion of disturbed surfaces (upgraded roadway)

  Approximate disturbed area =
  2 (1.3 mi x 5,280 ft/mi) (7 ft) (acre/43,560 sq ft)
  = 2.2 acres

  Emission rate = (0.46) (2.2) = 1.0 T/yr
  (with 50 percent fugitive dust control) = 0.5 T/yr

Fugitive dust emissions from utility lines and communications cable installation are expected to consist of emissions from trenching operations, bulldozing overburden material, and wind erosion of disturbed surfaces.

Based on typical engineering practices for trenching operations, an average amount of material which could be removed in a day is approximately 1,300 cy. For purposes of this analysis, a 6 foot deep trench was assumed, with a 3 foot width and one-half by 1 foot sloping sides. A 24 sq ft area of material would be removed for each 1 foot length of trench. Assuming 4 hours of trenching and 4 hours of bulldozing per day, a total length of 1,460 feet per day could be dug.

Empirical equations developed by the EPA in AP-42 and also referenced in the Wyoming State Emission Factors from Mining Operations were used to develop emission factors for the cable installation operations. These emission factor calculations are presented below:

- Trenching Operations

  $$\text{Emission factor} = 0.0018\ \frac{(s/5)\quad (u/5)}{(M/2)^2\quad (Y/6)}\ \text{lb/T}$$

  (Developed for emissions from front-end loaders for aggregate storage piles and materials handling [EPA 1982].)

  s = silt content = 19 percent
  u = average wind speed = 13 mph (U.S. Department of Commerce 1982)
  M = moisture content = 5 percent
  Y = bucket capacity = 0.83 cy

  Total soil removed: (1,460 ft) (24 sq ft) (100 lb/cf) (T/2,000 lb)
  = 1,752.0 tons

  Average soil density = 100 lb/cf

  Emission rate = 0.0018 [(19/5) (13/5)] / [$(5/2)^2$ (0.83/6)]
  = (0.0206 lb/T) (1,752.0 tons)
  = 36.1 lb/day
  (with 50 percent fugitive dust control) = 18.1 lb/day

- Bulldozing overburden material

  $$E = \frac{5.7\ (s)^{1.2}}{(M)^{1.3}}\ \text{lb/hr}$$

  s = silt content = 19 percent
  M = moisture content = 5 percent
  Emission rate = 5.7 $(19)^{1.2}$ / $(5)^{1.3}$ = 24.1 lb/hr
  (24.1) (4) = 96.3 lb/day
  (with 50 percent fugitive dust control) = 48.2 lb/day

- Wind erosion of disturbed surfaces

  Emission factor = AIKCLV T/acre/yr

  Approximate disturbed area = (20 ft) (75,300 ft) =
  (1,506,000 sq ft) (acre/43,560 sq ft) = 34.6 acres

  Emission rate = (0.46) (34.6) = 15.9 T/yr
  (with 50 percent fugitive dust control) = 7.9 T/yr

C.1.3 Construction of Project-Induced Housing Developments

Emission rates for construction of housing units were calculated based on the total amount of disturbed acreage for housing units and access roadways. The peak net housing demand for Cheyenne was predicted to occur in 1986; 93 single-family, 80 mobile, and 6 multifamily dwelling units. The highest peak net housing demand outside of Cheyenne was predicted to occur in 1988 in Pine Bluffs; 14 multifamily and 11 mobile dwelling units. The maximum total acreage assumed to be used at any one location for housing (Cheyenne neighborhood number 27) is 8.2 acres for 48 mobile homes. This location was selected for modeling the worst-case housing construction impacts on local air quality. Assuming approximately 2 units along a 100-foot section of roadway (one on each side) and a total roadway and sidewalk width of 44 feet, approximately 2.4 acres would be used for access roadways.

Using the 1.2 T/acre/month emission factor for general construction activities adjusted to 18 workdays per month and the level of activity per day, the annual emission rate would be:

Emission rate = (0.04 T/acre) x (10.6 acre/year)
= 0.4 T/yr

Assuming that the construction activity would occur in 1 month and adjusting the emission factor to T/acre/day, the 24-hour emission rate would be:

Emission rate = 0.42 T/18 days
= (0.023 T/day) (2,000 lb/T)
= 46.7 lb/day

C.1.4 Resurfacing Deployment Area Roads

Emission factors for fugitive dust emissions from modification of existing unpaved DA roads were calculated using the same methods as those described for roadway construction on F.E. Warren AFB. The maximum 24-hour impacts on local air quality would be from the construction of paved roads. Assuming roadways would be 40 feet in width, approximately 800 cy of aggregate and 370 cy of asphalt concrete would be required per day. Using the average of 400 cy of material unloaded and graded per day, a 1,000 foot length of roadway could be completed by 2 work crews in 1 day. The emission factors developed for material unloading, grading of roadway surfaces, and travel on unpaved roadways are presented below.

- Material unloading
  Emission factor = (0.017) (0.75) lb/T
  Based on weight of coarse gravel: 1.67 T/cy
  Total tons of material loaded: (2 crews) (400 cy/day) (1.67 T/cy)
  = 1336 T/day
  Emission Rate: (0.017) (0.75) (1336) = 17.0 lb/day
  (with 50 percent fugitive dust control) = 8.5 lb/day

- Grading and land clearing of roadway base
  Emission factor = 32 lb/hr per work crew
  Emission rate (8-hr day) = (2) (32) (8) = 512 lb/day
  (with 50 percent fugitive dust control) = 256 lb/day

- HDV travel on unpaved roads
  Emission factor = (0.81s) (S/30) (0.62) (W/4) lb/VMT
  VMT = vehicle miles traveled
  = (length road segment) (number of vehicles/day)
  = (1,000 ft) (65 vehicles/day) (mile/5,280 ft)
  = 12.31 vehicle-miles/day
  Number of vehicles per day =

  $$\left(\frac{800 \text{ cy of aggregate/day}}{18 \text{ cy/vehicle}}\right) + \left(\frac{370 \text{ cy of asphalt/day}}{18 \text{ cy/vehicle}}\right)$$

  = 44 + 21 = 65 vehicles/day
  Emission rate = (0.81) (19) (20/30) (0.62) (10/4) (12.31)
  = 195.8 lb/day
  (with 50 percent fugitive dust control) = 97.9 lb/day

The total 24-hour emission rate for all sources is 362 lb/day. Since the source is not stationary, the annual impact at any one receptor will be negligible and an annual emission rate was therefore not calculated.

C.1.5 Installation of Communications Cables

Fugitive dust emissions from cable installation are expected to consist of emissions from trenching operations, bulldozing overburden material, and wind erosion of disturbed surfaces.

Based on typical engineering practices for trenching operations, an average amount of material which could be removed in a day is approximately 1,300 cy. For purposes of this analysis, a 6 foot deep trench was assumed, with a 3 foot width and one-half by 1 foot sloping sides. A 24 sq ft area of material would be removed for each 1 foot length of trench. Assuming 4 hours of trenching and 4 hours of bulldozing, a total length of 1,460 feet per day could be dug.

- Trenching Operations

  $$\text{Emission factor} = 0.0018 \ \frac{(s/5)}{(M/2)^2} \ \frac{(u/5)}{(Y/6)} \ \text{lb/T}$$

  Total soil removed: (1,460 ft) (24 sq ft) (100 lb/cf)
  (T/2,000 lb) = 1,752.0 tons
  Average soil density = 100 lb/cf

Emission rate = 0.0018 (19/5) (13/5)/$(5/2)^2$ (0.83/6)
= (0.0206 lb/T) (1,752.0 tons)
= 36.1 lb/day
(with 50 percent fugitive dust control) = 18.1 lb/day

o Bulldozing overburden material

$$E = \frac{5.7 \ (s)^{1.2}}{(M)\ 1.3} \text{ lb/hr}$$

Emission rate = 5.7 $(19)^{1.2}$ /$(5)^{1.3}$ = 24.1 lb/hr
(24.1) (4) = 96.3 lb/day
(with 50 percent fugitive dust control) = 48.2 lb/day

o Wind erosion of disturbed surfaces

Emission factor = AIKCLV T/acre/yr

Approximate disturbed area = (20 ft) (290,400 ft) (acre/ 43,560 sq ft)
= 133.3 acres
Emission rate = (0.46) (133.3) = 61.3 T/yr
(with 50 percent fugitive dust control) = 30.7 T/yr (168.2 lb/day)

The total 24-hour emission rate for all sources is 234.5 lb/day. Since the source is not stationary, the annual impact at any one receptor will be negligible and an annual emission rate was therefore not calculated.

C.1.6 Modification of the Launch Facility Access Roads and Site Pads

Exterior construction at the LF site is expected to consist of adding 30 tons of fill around the site entrance and upgrading on the average 275 feet of LF access roads. Emission factors for construction activities were calculated using the previously defined equations for upgrading unpaved roadways. These calculations are:

o Material unloading

Amount of material in tons (based on 1.67 T/cy : coarse gravel)
Site Pad : 30 tons
Roads : (175.9 cy) (1.67 T/cy) = 293.7 tons

Emission rate = (0.017) (293.7 + 30) (0.75) = 4.1 lb/day
(with 50 percent fugitive dust control) = 2.1 lb/day

o Grading roadway surfaces and site pad

Construction time (based on 400 cy/day) = 4 hr
Emission rate = (32 lb/hr) (4 hr/day) = 128.0 lb/day
(with 50 percent fugitive dust control) = 64.0 lb/day

o Equipment travel on unpaved roads

Number of vehicles per day = 194 cy (material)/(18 cy/dump truck)
= 11 vehicles/day

VMT = (275 ft) (11 vehicles/day) (mi/5,280 ft) = 0.57 vehicle-miles/day

Emission rate = (0.81) (19) (20/30) (0.62) (10/4) (0.57) = 9.1 lb/day

(with 50 percent fugitive dust control) = 4.6 lb/day

The total 24-hour emission rate for all sources is 70.7 lb/day.

Annual emissions were not calculated for construction at the LFs due to the short duration of construction activities.

C.1.7 Activities at a Dispatch Station

The fugitive dust generated from a dispatch station is mainly from the wind erosion of the disturbed land. For purpose of this analysis, an area of 5 acres was assumed to be disturbed.

Empirical equations developed by the EPA in AP-42 were used to estimate the emission rate. These calculations are presented below:

- Wind erosion of disturbed surfaces

  Emission factor = AIKCLV T/acre/yr
  = 0.46 T/acre/yr

  Approximate disturbed area = 5 acres
  Emission rate = (0.46) (5.0) = 2.3 T/yr
  (2.3) (2,000 lb/T)/(365 days/year) = 12.6 lb/day
  (with 50 percent fugitive dust control) = 6.3 lb/day

C.1.8 Conversion Formulas

All emission rates were converted to grams per second per square meter (grams/sec/m^2) for input into the air quality dispersion models using the following conversion formulas:

- Annual emission factors: (2,000 lb/T) (453.6 gm/lb) (day/864,000 sec x year/365 days)/(area of the source, m^2)

- 24-hour emission factors: (2,000 lb/T) (453.6 gm/lb) (day/864,000 sec)/(area of the source, m^2)

C.2 Calculations for Visibility Screening Procedure

C.2.1 Introduction

The following screening analysis calculations presents procedures used in EPA's Workbook for Estimating Visibility Impairment (July 1980b). The analysis was undertaken to determine the potential impact of project construction activities on the nearby Class I/Category I area.

The level-1 visibility screening analysis is a simple, straightforward calculation designed to identify those emissions sources that have little potential for adversely affecting visiblity in a Class I/Category I area. If a source passes this first screening test, it would not be likely to cause visibility impairment, and further analysis of potential visibility impacts would be unnecessary. If the source fails this test, additional screening analysis would be needed to assess potential impacts.

The input parameters needed to evaluate potential visibility impacts with this screening analysis procedure are as follows:

- Minimum distance of the emissions source from a potentially affected Class I/Category I area;
- Location of the emissions source and Class I/Category I area; and
- Pollution emission rates.

C.2.2 Level - 1 Screening Analysis Procedure

a) Determine the minimum straight-line distance x in kilometers between the emissions source and the closest boundary of a Class I/Category I area.

To facilitate the modeling, all emission sources were assumed to be combined and located at the southern boundary of F.E. Warren AFB. The distance of this point to the closest Class I area (Rocky Mountain National Park) is approximately 58 miles (92.8 km).

b) Determine σ_z = (vertical dispersion parameter) corresponding to distance x and Pasquill - Gifford stability F, σ_z= 95 m.

c) Compute the plume dispersion parameter, p(sec/m^2).

$$p = \frac{(2.0 \times 10^8 \text{ sec})}{\sigma_z x}$$

$$p = \frac{(2.0 \times 10^8 \text{ sec})}{(95 \text{ m})\ (92.8 \text{ km})} = 22{,}686 \text{ sec/m}^2$$

d) Determine total mass emission rates in metric tons (MT) per day for peak emissions year (1986):

$Q_{particulates}$= 12.03 MT/Day

Q_{NO_x} = 1.21 MT/Day

Q_{SO_2} = 0.30 MT/Day

e) Calculate the optical thickness of particulates and NO_2:

$$\tau_{particulates} = (10 \times 10^{-7}) pQ_{particulates} = (10 \times 10^{-7})\ (22{,}686)\ (12.03)$$
$$= 0.27 \text{ 1/m}$$

$$\tau_{NO_2} = (1.7 \times 10^{-7}) pQ_{NO_x} = (1.7 \times 10^{-7})(22{,}686)(1.21) = 4.6 \times 10^{-3} \text{ 1/m}$$

f) Determine background visual range (Rvo); Rvo = 170 km for the area between the source and the Class I airshed.

g) Calculate the following optical thickness parameter for the primary aerosol:

$$\tau_{aerosol} = (1.06 \times 10^{-5})\ (Rvo)(Q_{particulates} + 1.31\ Q_{SO_2})$$

$$\tau_{aerosol} = (1.06 \times 10^{-5})(170)[12.03 + 1.31(0.3)]$$

$$\tau_{aerosol} = 2.24 \times 10^{-2}\ 1/m$$

h) Calculate the following contrast parameters:

C_1 (all sources combined): Plume contrast against the sky.

$$C_1 = \frac{-\tau_{NO_2}}{\tau_{particulates} + \tau_{NO_2}} [1 - EXP(-\tau_{particulates} - \tau_{NO_2})]$$
$$[EXP(-0.78)(x/Rvo)]$$

$$C_1 = \frac{-(4.6 \times 10^{-3})}{0.27 + (4.6 \times 10^{-3})} [1 - EXP(-0.27 - 4.6 \times 10^{-3})]$$
$$[EXP([-0.78][92.8/170])]$$

$$C_1 = |-7.94 \times 10^{-3}| = 7.94 \times 10^{-3}$$

C_2 (all sources combined): Reduction in sky/terrain contrast due to NO_2 and particulates.

$$C_2 = [1 - (\frac{1}{C_1 + 1})EXP(-\tau_{particulates} - \tau_{NO_2})][EXP(-1.56)\ (x/Rvo)]$$

$$C_2 = [1 - (\frac{1}{7.94 \times 10^{-3} + 1})EXP(-0.27 - 4.6 \times 10^{-3})]$$
$$[EXP([-1.56][92.8/170])]$$

$$C_2 = 11.7 \times 10^{-2}$$

C_3 (all sources combined): Reduction in sky/terrain contrast due to sulfate aerosol and particulates.

$$C_3 = 0.368[1 - EXP(-\tau_{aerosol})]$$

$$C_3 = 0.368[1-EXP(-2.24 \times 10^{-2})]$$

$$C_3 = 8.0 \times 10^{-3}$$

i) Since the absolute values of C_1, C_2, or C_3 from any single source location would all be less than 0.10, it is highly unlikely that the emissions source would cause adverse visibility impairment in Class I/ Category I areas and, therefore, further analysis would be unnecessary. It should be noted that the visibility impairment analysis was based on conservatively combining all project-related pollutant sources, throughout the ROI, into a single source at a single location.

APPENDIX D

APPENDIX D
REGIONAL AND PROJECT-RELATED EMISSIONS

D.1 Introduction

Estimates of total emissions of total suspended particulates (TSP), oxides of sulfur (SO_x), oxides of nitrogen (NO_x), carbon monoxide (CO), and volatile organic compounds (VOC) were determined for the Proposed Action, project element alternatives and the No Action Alternative. The emission values, which are based on numerous assumptions and estimations, should be considered conservative order-of-magnitude values to be used primarily for comparison between future baseline and the Proposed Action.

The activities evaluated in this analysis include fugitive dust emissions from construction activities, exhaust emissions from construction vehicles, inmigrant population-related emissions, and emissions from the F.E. Warren AFB Central Heating Plant.

Emission factors, emission rates, and applicable mathematical equations utilized in the analysis are the same as those discussed in Appendix C.

D.2 Fugitive Dust Emissions from Construction Activities

This analysis concerns itself with particulates generated from construction activities such as equipment travel on unpaved roads, land clearing, trenching operations, and roadway modification. This section is broken up into six subsections encompassing all construction activities both on and offbase and both directly and indirectly related to project activities. All results are presented in tons per year for each pollutant. For the most part, this section is an expansion of Appendix C, taking either annual or short-term emissions of total suspended particulates and adjusting them appropriately.

D.2.1 Construction of New Buildings and Roadways on F.E. Warren AFB

Fugitive dust emissions from construction activities at F.E. Warren AFB were based on estimates of direct construction-related disturbed acreage, wind erosion disturbed acreage, annual construction manpower distributions, and scheduled construction start-and-completion dates. The estimated annual amounts of disturbed acreage and emission rates are provided in Table D.2-1.

D.2.2 Construction of Project-Induced Housing Developments

Fugitive dust emissions from construction of mobile homes and single-family and multifamily residential homes were based on the number of units projected to be built and acreage disturbed. Roadways are included in the figures and treated as general construction. The annual amounts of disturbed acreage and emission rates are provided in Table D.2-2.

Table D.2-1

F.E. WARREN AFB CONSTRUCTION ACTIVITY EMISSION RATES
(T/yr)

Location	Annual Period 1984	1985	1986
Stage Storage Area			
- Construction	0.01 (0.01)	3.48 (4.83)	0.17 (0.24)
- Erosion	0.01 (2.58)	0.59 (2.58)	0.14 (2.58)
Weapons Storage Area			
- Construction	0.14 (0.20)	1.71 (2.37)	0.08 (0.11)
- Erosion	0.67 (9.72)	2.24 (9.72)	0.54 (9.72)
Integrated Support Complex	1.49 (2.07)	4.73 (6.57)	
Training and Instruction Facilities		1.79 (2.48)	0.17 (0.24)
Roadways			
- Construction		14.28[a]	
- Erosion		6.78 (29.47)	
Utility Lines and Communication Cables			
- Construction		1.66[b]	
- Erosion		7.75 (33.7)	

Notes: Top Value: Emission Rate (T/yr)
Bottom Value: Disturbed Acreage (acres)

[a] 7.5 miles of new roadway, 1.3 miles of upgraded roadway
[b] 13.9 miles of trenches

Table D.2-2

EMISSION RATES FOR PROJECTED PROJECT-INDUCED HOUSING
(T/yr)

	Annual Period				
Type of Construction Activity	1985	1986	1987	1988	1989
Mobile Homes	0.36	0.58	0.18	0.09	0.06
Mobile Home Roads	0.11	0.17	0.05	0.03	0.02
Single-Family Residential Homes	N/A	0.93	0.40	N/A	N/A
Single-Family Residential Home Roads	N/A	0.19	0.08	N/A	N/A
Multifamily Residential Homes	N/A	0.06	0.01	0.05	N/A
Multifamily Residential Home Roads	N/A	0.04	0.01	0.03	N/A

Note: N/A Data not available

D.2.3 Upgrading Unpaved Deployment Area Roads

For the purposes of this analysis, fugitive dust emissions from Deployment Area (DA) roads were based on upgrade of 642 miles of roadway, and additional paving for the shoulders of 32 miles of roadway. The 362 lb/day emission rate calculated in Appendix C included construction equipment travel on unpaved roads at the actual areas under construction. Additional emissions for construction equipment and light-duty vehicle travel on haul roads leading to the construction sites were determined as follows:

Heavy-Duty Vehicles (HDV):

Vehicle Miles Traveled (VMT):
1985: (86 trucks)(3 trips/day)(162 days) (3 mi/trip) = 125,388 miles
1986: (104 trucks)(3 trips/day)(216 days) (3 mi/trip) = 202,176 miles
1987: (89 trucks)(3 trips/day)(108 days) (3 mi/trip) = 86,508 miles

Light-Duty Vehicles (LDV)

(VMT):
1985: (27 vehicles)(1 trip/day)(162 days) (3 mi/trip) = 13,122 miles
1986: (26 vehicles)(1 trip/day)(216 days) (3 mi/trip) = 16,864 miles
1987: (26 vehicles)(1 trip/day)(108 days) (3 mi/trip) = 8,424 miles

These estimates are based on a travel distance of 3 miles per vehicle (average to and from site). The LDV trips per day are based on an average of 2.5 workers per vehicle.

Wyoming's haul road emissions formula was used to calculate fugitive dust emissions as follows:

HDV: Total Emissions = (0.81)(12)(30/30)(0.62)(10/4)(414,072)/(2,000 lbs/T)
= 3119.2 T/project

LDV: Total Emissions = (0.81)(12)(30/30)(0.62)(4/4)(38,410)/(2,000 lbs/T)
= 115.8 T/project

Emission rates by year are provided in Table D.2-3.

Table D.2-3

DEPLOYMENT AREA ROADWAY MODIFICATION EMISSION RATES
(T/yr)

Type of Activity	Annual Period 1985	1986	1987
DA Roadway Construction	146.4	243.6	97.7
HDV Travel to/from Site	935.8	1,559.6	623.8
LDV Travel to/from Site	34.7	57.9	23.2

D.2.4 Installation of Communications Cables

Trenching, bulldozing, and wind erosion of disturbed surfaces are expected to be the primary sources of fugitive emissions from installation of communication cables. The analysis was based upon an emission rate of 240.4 pounds per day (lb/day), 1,460 feet of activity per day, and approximately 110 miles of cable to be buried over a period of 2 years. Emission rates by year are provided in Table D.2.4.

Table D.2-4

COMMUNICATIONS CABLE TRENCHING OPERATIONS EMISSION RATES
(T/yr)

Type of Activity	Annual Period 1987	1988
Cable Laying	6.6	6.6
Wind Erosion	30.6	30.6

D.2.5 Modification of Launch Facility Access Roads and Site Pads

This activity consists of upgrading an average of 275 feet of Launch Facility (LF) access roadway, widening the site pad, travel of equipment and workers on unpaved roads, and travel of the stage transporter (S/T) vehicle to the site. The analysis was based upon an emission rate of 66.1 lb/day and 1 day of above-ground construction activity per silo. The yearly distribution of emissions is based upon the annual manpower distributions.

The travel of vehicles on unpaved roads (other than around the site) is calculated below:

HDV: VMT = (11 vehicles/silo)(100 silos)(6 mi/vehicle)(1 day/silo)
VMT = 6,600 miles

HDV: VMT = (5 vehicles/silo)(100 silos)(6 mi/vehicle)(65 days/silo)
VMT = 195,000 miles

LDV: VMT = (15 vehicles/silo)(100 silos)(6 mi/vehicle)(65 days/silo)
VMT = 585,000 miles

S/T and transportation of missile stages:

HDV: VMT = (1 vehicle/silo)(100 silos)(6 mi/vehicle)(5 days/silo)
VMT = 3,000 miles

LDV: VMT = (16 vehicles/silo)(100 silos)(6 mi/vehicle)(5 days/silo)
VMT = 48,000 miles

For HDVs, the 6-mile figure was based on an average roundtrip to each silo (2 x 3 miles). LDV trips per silo were based on an average of 2.5 workers per vehicle. Five trips were projected for delivery of the missiles. Wyoming's haul road emissions formula was used to calculate fugitive dust emissions as follows:

HDV: Total
Emissions = (0.81)(12)(30/30)(0.62)(10/4)(6,600 mi)/(2,000 lbs/T)
= 49.7 T/project

HDV: Total
Emissions = (0.81)(12)(30/30)(0.62)(10/4)(195,000 mi)/(2,000 lbs/T)
= 1,468.9 T/project

LDV: Total
Emissions = (0.81)(12)(30/30)(0.62)(4/4)(585,000 mi)/(2,000 lbs/T)
= 1,763.0 T/project

S/T: HDV:
Total
Emissions = (0.81)(12)(20/30)(0.62)(50/4)(3,000 mi)/(2,000 lbs/T)
= 75.4 T/project

LDV:

Total Emissions = (0.81)(12)(30/30)(0.62)(4/4)(48,000 mi)/(2,000 lbs/T)
= 144.6 T/project

It was estimated that the S/T vehicle would travel no faster than 20 miles per hour (mph) on unpaved roadways. There are approximately 50 tires on the S/T which is a variation of the usual 10-tire HDV class. Emission rates by year are provided in Table D.2-5.

Table D.2-5

LAUNCH FACILITY ACCESS ROADS AND SITE PAD EMISSION RATES (T/yr)

	Annual Period				
Type of Activity	1985	1986	1987	1988	1989
LF Access Road and Site Pad Construction	0.7	1.0	1.0	0.7	0.0
HDV Travel to/from Site	9.9	294.0	470.3	465.3	279.1
LDV Travel to/from Site	N/A	335.0	546.5	546.5	335.0
HDV Missile Delivery Travel	N/A	14.3	23.4	23.4	14.3
LDV Missile Delivery Travel	N/A	27.5	44.8	44.8	27.5

Note: N/A Data not available

D.2.6 Activities at the Dispatch Stations

The fugitive dust generated from dispatch stations is mainly from the wind erosion of disturbed land. An area of 5 acres of land was assumed to be disturbed at each station.

Emission Rate = 2.30 T/year
(With 50 percent fugitive dust control) = 1.2 T/yr

D.2.7 Summary of All Construction Fugitive Dust Sources

The estimated total construction activity fugitive dust emissions are provided in Table D.2-6.

Table D.2-6

TOTAL CONSTRUCTION ACTIVITY FUGITIVE DUST EMISSIONS
(T/yr)

Category	Annual Period					
	1984	1985	1986	1987	1988	1989
I) Construction at F.E. Warren AFB	2.3	45.0	1.1	N/A	N/A	N/A
II) Induced-Housing Construction	N/A	0.5	2.0	0.7	0.2	0.1
III) Deployment Area Roadway Modification	N/A	1,116.9	1,861.1	744.7	N/A	N/A
IV) Communications Cables	N/A	N/A	N/A	37.2	37.2	N/A
V) Modification of Launch Facility Access Roads and Site Pads	N/A	10.6	671.8	1,086.0	1,080.7	655.9
VI) Dispatch Stations	N/A	N/A	1.2	1.2	1.2	1.2
TOTAL BY YEAR:	2.3	1,173.0	2,537.2	1,869.8	1,119.8	657.2

Notes: N/A Not Applicable

D.3 Exhaust Emissions From Construction Equipment

This analysis develops pollutant emissions from exhaust emissions. Exhaust emission factors were obtained from AP-42 (EPA 1981b). Diesel-powered construction equipment information was obtained from the Atmospheric Resources M-X Environmental Technical Report (Henningson, Durham, and Richardson 1980). An 8-hour workday is assumed with 216 working days, or less, if appropriate, per year. All heavy construction equipment and dump trucks are assumed to be diesel-fuel powered. Only major pieces of construction equipment for which emissions are known are included in this analysis. The number and types of equipment projected to be used for each activity were estimated from standard construction practices and the amount of area under construction at any given time. The number of days construction would occur was based on estimated work pace and work schedules.

D.3.1 Construction of New Buildings and Roadways on F.E. Warren AFB

The estimated maximum disturbed acreage during the peak year (1985) for building construction is 16.25 acres. Additionally, all roadway work and trenching operations were assumed to occur in 1985. Because of cost and availability of equipment, usually only 1 to 2 pieces of the types of equipment listed in Table D.3-1 would be used at any given time. Continuous emissions from HDVs for an 8-hour workday were assumed.

The estimated number of 8-hour workdays that construction would be occurring onsite, along with the number of equipment types is provided in Table D.3-1.

D.3.2 Construction of Project-Induced Housing Developments

The following analysis is based on the projected construction of 53 mobile homes in 1985; 86 mobile homes, 19 multifamily homes, and 93 single-family homes in 1986; 27 mobile homes, 3 multifamily homes, and 40 single-family homes in 1987; 13 mobile homes and 14 multifamily homes in 1988; and 9 mobile homes in 1989. It was estimated that no more than four pieces of each equipment type would be needed during the peak year. Roadway construction is included in these emission figures. It was estimated that 20 HDVs per day would be active throughout all construction sites. The number of workdays and number of types of equipment expected to be utilized are provided in Table D.3-2.

Table D.3-1

WORKDAYS AND QUANTITY AND TYPES OF EQUIPMENT FOR
F.E. WARREN AFB CONSTRUCTION

New Building Construction

	Annual Period					
	1984		1985		1986	
Type of Equipment	Amount	Work-days	Amount	Work-days	Amount	Work-days
Track Tractor	1	54	1	216	1	54
Wheel Tractor	1	54	1	216	1	54
Scraper	1	54	1	216	1	54
Motor Grader	1	54	1	216	1	54
Wheel Loader	1	54	1	216	1	54
Track Loader	1	54	1	216	1	54
Roller	1	54	1	216	1	54
Crane (Miscellaneous)	1	54	1	216	1	54
HDV	5	54	5	216	5	54

New Roadway Construction/Roadway Upgrading

	1985	
Type of Equipment	Amount	Workdays
Scraper	1	216
Roller	1	216
Paver (Miscellaneous)	1	216
HDV	3	216

Installation of Utility Lines
and Communication Cables

	1985	
Type of Equipment	Amount	Workdays
Track Tractor	2	50
HDV	1	50

Table D.3-2

WORKDAYS AND QUANTITY AND TYPES OF EQUIPMENT FOR CONSTRUCTION OF PROJECT-INDUCED HOUSING

Type of Equipment	1985 Amount	1985 Workdays	1986 Amount	1986 Workdays	1987 Amount	1987 Workdays
Track Tractor	1	36	4	108	2	54
Wheel Tractor	1	36	4	108	2	54
Scraper	1	36	4	108	2	54
Motor Grader	1	36	4	108	2	54
Wheel Loader	1	36	4	108	2	54
Track Loader	1	36	4	108	2	54
Roller	1	36	4	108	2	54
HDV	5	36	20	108	10	54

Type of Equipment	1988 Amount	1988 Workdays	1989 Amount	1989 Workdays
Track Tractor	1	36	1	18
Wheel Tractor	1	36	1	18
Scraper	1	36	1	18
Motor Grader	1	36	1	18
Wheel Loader	1	36	1	18
Track Loader	1	36	1	18
Roller	1	36	1	18
HDV	5	36	5	18

D.3.3 Upgrading Unpaved Deployment Area Roads

For the purposes of this analysis, 642 miles of roadway were assumed to be upgraded as well as additional paving of 32 miles of roadway shoulders. Resurfacing Option B, which consists of paving all gravel Defense Access Roads, was conservatively selected for this calculation. The estimated amounts of equipment and workdays are provided in Table D.3-3.

Table D.3-3

WORKDAYS AND QUANTITY AND TYPES OF EQUIPMENT
FOR UPGRADE OF DEPLOYMENT AREA ROADS

	Annual Period					
	1985		1986		1987	
Type of Equipment	Amount	Work-days	Amount	Work-days	Amount	Work-days
Track Tractor	8	162	8	216	8	108
Scraper	8	162	8	216	8	108
Motor Grader	8	162	8	216	8	108
Wheel Loader	8	162	8	216	8	108
Roller	10	162	8	216	8	108
Paver	5	162	4	216	4	108
HDV	86	162	104	216	89	108

D.3.4 Installation of Communications Cables

The placement of the communications cables is assumed to require one backhoe for trench digging, one HDV for cable laying, and one dozer for trench filling. This analysis assumes that the 110 miles of cable can be buried in a 2-year period at a rate of 1,460 feet per day. The 110 miles was the sum of the 5 longest distances specified for the cable path options. Estimated amounts of equipment and workdays are provided in Table D.3-4. The dozer is represented by the track-laying tractor.

Table D.3-4

WORKDAYS AND QUANTITY AND TYPES OF EQUIPMENT FOR
INSTALLATION OF COMMUNICATIONS CABLES

	Annual Period			
	1987		1988	
	Amount	Work-days	Amount	Work-days
Track Tractor	2	199	2	199
HDV	1	199	1	199

D.3.5 Modification of Launch Facility Access Roads and Site Pads

The LF access roads average about 275 feet in length. The roadway upgrading along with the lengthening of the pad will require minimum equipment and time. The pad lengthening consists of some scraping, structural steel work, and concrete pouring. It was assumed that only one site will be modified at a time. It is also estimated that only one piece of equipment type will be needed per site and that the modification will be accomplished in one 8-hour workday. HDV movement is assumed for 2 workdays. Equipment information is provided in Table D.3-5.

TABLE D.3-5

WORKDAYS AND QUANTITY AND TYPES OF EQUIPMENT FOR MODIFICATION OF LAUNCH FACILITY ACCESS ROADS AND SITE PADS

	Annual Period							
	1985		1986		1987		1988	
Type of Equipment	Amount	Workdays	Amount	Workdays	Amount	Workdays	Amount	Workdays
Track Tractor	1	20	1	30	1	30	1	20
Wheel Tractor	1	20	1	30	1	30	1	20
Scraper	1	20	1	30	1	30	1	20
Motor Grader	1	20	1	30	1	30	1	20
Wheel Loader	1	20	1	30	1	30	1	20
Track Loader	1	20	1	30	1	30	1	20
Roller	1	20	1	30	1	30	1	20
HDV	11	40	11	60	11	60	11	40

D.3.6 Summary of All Exhaust Emission Sources

The HDV numbers were converted to VMT for emissions calculations. It was estimated that a typical HDV (i.e., a dump truck) would travel 20 miles in 1 hour, on the average, if idle time is included. Idle emissions were not included in the analysis. This translates to 160 VMT per day per vehicle.

Summing the total number of hours per year of each equipment type and applying the United States Environmental Protection Agency's (EPA) emission factors from Tables D.3-6 and D.3-7, the total emissions of each pollutant were calculated.

The estimated emissions from all pollutant sources by year are provided in Table D.3-8.

Table D.3-6

EMISSION FACTORS FOR HEAVY-DUTY, DIESEL-POWERED VEHICLES

Pollutant	Truck Emissions (grams/mile)
Particulates	1.3
Sulfur oxides (SO_x as SO_2)	2.8
Carbon monoxide	28.7
Hydrocarbons	4.6
Nitrogen oxides (NO_x as NO_2)	20.9

Source: AP-42 (EPA 1981b)

Table D.3-7

EMISSION FACTORS FOR HEAVY-DUTY,
DIESEL-POWERED CONSTRUCTION EQUIPMENT
(lbs/hr)

Type of Equipment	Pollutant				
	TSP	SO_x	NO_x	CO	VOC(HC)
Track Tractor	0.112	0.137	1.47	0.386	0.110
Wheel Tractor	0.136	0.090	0.994	2.15	0.148
Wheel Dozer	0.165	0.348	5.05	0.739	0.234
Scraper	0.406	0.463	6.22	1.46	0.626
Motor Grader	0.061	0.086	1.05	0.215	0.054
Wheel Loader	0.172	0.182	2.40	0.553	0.187
Track Loader	0.058	0.076	0.584	0.160	0.032
Off-Highway Truck	0.256	0.454	7.63	1.34	0.437
Roller	0.050	0.067	1.04	0.184	0.054
Miscellaneous	0.139	0.143	2.27	0.414	0.157

Source: AP-42 (EPA 1981b).

Table D.3-8

EXHAUST EMISSIONS SUMMARY BY YEAR
(T/yr)

Construction Category	TSP	SO_X	NO_X	CO	VOC
			1984		
I. F.E. Warren AFB	0.3	0.4	4.5	2.6	0.5
TOTAL:	0.3	0.4	4.5	2.6	0.5
			1985		
I. F.E. Warren AFB	2.0	2.7	30.3	17.2	3.6
II. Induced Housing	0.2	0.2	2.6	1.6	0.3
III. DA Roads	8.1	12.5	127.1	87.3	17.1
IV. LFs	0.2	0.3	2.7	2.6	0.6
TOTAL:	10.5	15.7	162.7	108.7	21.6
			1986		
I. F.E. Warren AFB	0.3	0.4	4.5	2.6	0.5
II. Induced Housing	2.2	3.0	31.1	19.7	3.8
III. DA Roads	11.2	18.0	174.8	134.2	25.9
IV. LFs	0.3	0.5	4.1	3.9	0.7
TOTAL:	14.0	21.9	214.4	160.4	30.9
			1987		
II. Induced Housing	0.6	0.7	7.8	4.9	1.0
III. DA Roads	5.2	8.2	81.4	59.0	11.6
IV. Communications Cables	0.2	0.3	3.2	1.7	0.3
V. LFs	0.3	0.5	4.1	3.9	0.7
TOTAL:	6.3	9.7	96.5	69.5	13.6
			1988		
II. Induced Housing	0.2	0.2	2.6	1.6	0.3
IV. Communications Cables	0.2	0.3	3.1	1.7	0.3
V. LFs	0.2	0.3	2.7	2.6	0.6
TOTAL:	0.6	0.8	8.4	5.9	1.2

Table D.3-8 Continued, page 2 of 2
EXHAUST EMISSIONS SUMMARY BY YEAR

	1989				
II. Induced Housing	0.1	0.1	1.4	0.8	0.1
TOTAL:	0.[illegible]	0.1	1.4	0.8	0.1
TOTAL ALL YEARS:	31.8	48.5	487.9	347.9	6/.9

D.4 Inmigrant Population-Related Emissions

Population is directly related to certain pollution emissions. These emissions are expected to grow in direct proportion to population changes. Whether or not this emission growth will result in subsequent air quality degradation depends on the location and density of emission sources and the local meteorological and topographical characteristics.

Baseline and project-related inmigrant population estimates were obtained from the socioeconomics task group. Baseline population, along with EPA's National Emission Inventory for the project area, were used to develop a per capita emissions rate. The per capita emissions rate was based on the total annual emissions from population-sensitive sources divided by the population over the same area. These population-related emission sources include: fuel combustion (residential and commercial-institutional), solid waste disposal (residential and commercial-institutional), air/water transportation (civil and commercial), land vehicles (gasoline, heavy-duty diesel, and off-highway diesel), and miscellaneous (unpaved roads, gasoline station evaporation loss, and solvent evaporation loss).

The per capita emissions rates were then multiplied by the projected baseline population and the average yearly project-related inmigrant population increases. The resultant yearly pollution emissions, along with the per capita emission rates and population figures, for the No Action Alternative and the project are presented in Tables D.4-1 and D.4-2, respectively.

Table D.4-1

BASELINE-NO ACTION ALTERNATIVE POPULATION EMISSIONS
(T/yr)

Pollutant:	Baseline Population[1]	TSP	SO_x	NO_x	CO	VOC
		Emissions				
1984	138,738	103,221	2,220	11,654	120,563	14,567
1985	141,111	104,987	2,258	11,853	122,625	14,817
1986	143,246	106,575	2,292	12,033	124,481	15,041
1987	145,709	108,408	2,331	12,240	126,621	15,299
1988	148,167	110,236	2,371	12,446	128,757	15,558
1989	150,817	112,208	2,413	12,669	131,060	15,836
1990	153,317	114,068	2,453	12,879	133,232	16,098
Per Capita Emission Factors:		0.744	0.016	0.084	0.869	0.105

Note: [1] Six-county area (Laramie, Platte, and Goshen, Wyoming; and Kimball, Banner, and Scotts Bluff, Nebraska).

Table D.4-2

PROPOSED ACTION INMIGRANT POPULATION EMISSIONS
(T/yr)

POLLUTANT:	Proposed Action Inmigrant Population Increase[1]	TSP	SO_x	NO_x	CO	VOC
		Emissions				
1984	275	205	4	23	239	29
1985	1,475	1,097	24	124	1,282	155
1986	2,875	2,139	46	242	2,498	302
1987	3,200	2,381	51	269	2,781	336
1988	3,025	2,251	48	254	2,692	318
1989	2,874	2,138	46	241	2,498	302
1990	1,200	893	19	101	1,043	126
Per Capita Emission Factors:		0.744	0.016	0.084	0.869	0.105

Note: [1] Six-county area (Laramie, Platte, and Goshen, Wyoming; and Kimball, Banner, and Scotts Bluff, Nebraska).

D.5 F.E. Warren AFB Central Heating Plant Emissions

Increased energy usage can be expected at the F.E. Warren AFB facility due to increased project and support buildings. The majority of this energy will be for space heating. The total increase in electrical load at F.E. Warren AFB is expected to be approximately 2,675 kilowatts (kW). The analysis will concentrate on increased heating requirements and their resultant increased pollution emissions from the onbase central heating plant.

The analysis is based on the following assumptions:

- o 340,000 square feet (sq ft) of additional building floor area;
- o The heat load in altered, existing buildings without additional floor space remains unchanged;
- o The efficiency of the heating plant and distribution system is 75 percent;
- o All new buildings except for those in the Stage Storage Area will be heated by the central heating plant; and
- o The British thermal unit rating of coal is 11,500 Btu/lb.

The emissions rate is based on the following assumptions:

- o High temperature, hot water system;
- o 55 MBtu per hour generation;
- o Additional coal usage of 1,300 tons per year;
- o Sulfur content of coal of 0.74;
- o Ash content of coal of 4 to 8 percent (6 percent average); and
- o Emission rates as follows:

TSP	SO_2	CO	NO_x	Organics
13A	0.38S	2	15	0.5 lb/T of coal

where A = 6 and S = 74.

A bag house is used to control particulates which is rated to be 99.8 percent efficient. The analysis will use 99 percent to be conservative. Table D.5-1 provides the estimated pollutant emissions in T/yr.

It is assumed the heating plant will generate these additional emissions, starting in 1985, and that they will remain constant for subsequent years.

Table D.5-1

F.E. WARREN AFB CENTRAL HEATING PLANT EMISSIONS
(T/yr)

Pollutant	Emissions
TSP	0.5
SO_2	18.3
NO_x	9.8
CO	1.3
Organics	0.3

D.6 Asphaltic Concrete Plants for Roadway Paving

Asphaltic concrete (asphaltic hot mix) is a paving material which consists of a combination of graded aggregate that is dried, heated, and evenly coated with hot asphalt cement, and is generally produced in batch processes. For this analysis, it was assumed that several portable batch plants will be operational at several locations in the DA. Asphaltic batch plants are required to be permitted by the appropriate air quality agencies in both Wyoming and Nebraska. It was conservatively assumed that 1,050,000 cy of asphalt will be required for paving DA roads.

o Density of asphalt = 155 lb/cf
  Total asphalt required = 2,197,125 tons

Emission factors and total emissions (tons) by year from the asphaltic concrete plant stacks are provided in Table D.6-1.

Table D.6-1

ASPHALTIC CONCRETE PLANT EMISSIONS
(T/yr)

	Pollutant				
	TSP	SO_x	NO_x	CO	VOC
1985	90.3	21.2	11.9	12.5	65.9
1986	150.5	35.3	19.8	20.9	110.0
1987	60.2	14.1	7.9	8.3	43.9
Emmission Factors (lb/T)[a]	0.274	0.292S[b]	0.036	0.038	0.20

Notes: [a] AP-42 (EPA 1981b)
[b] S = Sulfur content = 0.22 percent

D.7 Summary

The total of all sources of emissions for all years of construction activity is provided in Table D.7-1. The largest Proposed Action increment of yearly emissions over the projected baseline - No Action Alternative is approximately 5 percent as indicated in Table D.7-2.

Table D.7-1

TOTAL SHORT-TERM PROJECT-RELATED EMISSIONS
(T/yr)

	POLLUTANT				
	TSP	SO_x	NO_x	CO	VOC
1984	207.6	4.4	27.5	241.6	29.5
1985	2,371.3	79.2	308.3	1,404.5	242.8
1986	4,841.2	121.5	485.9	2,680.6	443.2
1987	4,317.8	168.8	383.2	2,860.2	393.8
1988	3,371.4	67.1	272.2	2,699.2	319.5
1989	2,795.8	64.4	252.2	2,500.1	302.4
TOTAL:	17,905.1	505.4	1,729.3	12,386.2	1,731.2

Table D.7-2

PERCENT OF PROJECT-RELATED EMISSIONS
OVER TOTAL PROJECTED BASELINE EMISSIONS FOR SELECTED YEARS

	POLLUTANT				
Year	TSP	SO_x	NO_x	CO	VOC
1985	2.0	3.5	2.6	1.1	1.6
1986	4.5	5.3	4.0	2.1	2.9
1990	0.8	1.5	0.9	0.8	0.8